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THE SMITHSONIAN INSTITUTION.

ITS ORIGIN, GROWTH, AND ACTIVITIES.

By Prof. HENRY CARRINGTON BOLTON, Ph. D.

PART I.—ORIGIN OF THE INSTITUTION.

WHEN the packet Mediator, commanded by Captain Christopher H. Champlin, sailed into New York harbor on the 28th day of August, 1838, after a stormy voyage of forty-three days from London, it brought in its hold a legacy from an Englishman to the United States of America, which was intended and destined to benefit all mankind. This precious freight consisted of eleven boxes, containing one hundred and five bags, each bag containing one thousand gold sovereigns. The boxes were carefully landed and stored for safe keeping in the Bank of America; a few days later the gold was sent to the United States Mint at Philadelphia, where it was immediately recoined into American money, yielding $508,318.46. This magnificent sum was the bequest of James Smithson, Esq., F. R. S., to the United States of America.

We propose in these articles to consider the purpose of this bequest, the manner in which the United States administers it, and the benefits to mankind accruing therefrom.

James Smithson was born in France, in the year 1765, of distinguished English parentage; as he himself wrote: "The best blood of England flows in my veins; on my father's side I am a Northumberlander, on my mother's I am related to kings."

Of Smithson's early life little is known. At Pembroke College, Oxford, the young man was an earnest student and showed a liking for scientific pursuits; he was especially proficient in chemistry, and spent his vacations in collecting ores and minerals

for analysis. He was graduated on the 26th of May, 1786; and the impulse for scientific research gained at the university influenced all his succeeding years. The highest ambition of an English man of science is to append to his name the honorable initials F. R. S., and to enjoy the privileges accorded to Fellows of the Royal Society. Recommended by Richard Kirwan, the Irish chemist,

JAMES SMITHSON AS AN OXFORD STUDENT, 1786.

Charles Blagden, the Secretary of the Society, Henry Cavendish, the wealthy and eccentric physicist, and others, Smithson was elected a Fellow exactly eleven months after leaving the university.

During his residence in London he cultivated the society of authors, artists, and men of science. "His mind was filled with a craving for intellectual development, and for the advancement of human knowledge. To enlarge the domain of thought, to discover new truths, and to make practical application of these for the promotion of civilization, were the great ends he had constantly in view." Smithson possessed large means; he never mar-

ried, and for family reasons preferred to live on the Continent, spending most of his time in France, Italy, and Germany; in his constant journeys he made observations on the climate, physical features, geology, and industries of the regions visited. He formed collections of minerals, and, for convenience of analyzing them, traveled with a portable chemical laboratory.

Living on the Continent, he acquired a cosmopolitan character, and formed acquaintance with the leading *savants* of the time; among his friends and corrrespondents were Gay-Lussac, the chemist; Haüy, the mineralogist; Arago, the astronomer; Biot, the physicist, of France; Berzelius, the chemist, of Sweden; and Davy, Black, Wollaston, Cavendish, Thomson, Smithson Tennant, chemical philosophers, of England. If it is "by a man's position among his contemporaries and competitors that his work may most justly be appraised," Smithson's scientific attainments must be rated very highly.

Between the years 1791 and 1825 Smithson published twenty-seven scientific papers, of which eight appeared in the Philosophical Transactions of the Royal Society and nineteen in Thomson's Annals of Philosophy. These memoirs embrace a wide range of research: the first deals with the curious deposit in bamboo called *tabasheer*, which he proved to be "siliceous earth"; the second was a "Chemical Analysis of Some Calamines," in which he established a new mineral species, afterward named *smithsonite* by Beudant (1832). The larger number of his papers deal with chemistry applied to mineral analysis, but he also discussed the nature of vegetables and insects, the origin of the earth, the crystalline form of ice, and an improved method of making coffee. An examination of these contributions to knowledge shows that he was no mere dilettante in science, and that he carried on his researches in a philosophic spirit for the sake of truth; all his writings exhibit keen perception, concise language, and accurate expression.

Of Smithson's personal traits and social character very little is known; his dislike of publicity, his natural reserve, as well as his residence in foreign countries, separated him from friends who might have given us particulars. It is said that he frequently narrated an anecdote of himself which illustrated his remarkable skill in analyzing minute quantities of substances, an ability which rivaled that of Dr. Wollaston. Happening to observe a tear gliding down a lady's cheek, he endeavored to catch it on a crystal vessel; one half the tear-drop escaped, but he subjected the other half to reagents, and detected what was then called microcosmic salt, muriate of soda, and some other saline constituents held in solution.

James Smithson died at the age of sixty-four years, on the 27th of June, 1829, at Genoa, Italy, and was buried in the Protestant

cemetery near that city. His death occurred in the same year with that of Davy, Wollaston, and Young, a fact mentioned by the President of the Royal Society in announcing the loss of members.

About three years before his death, Smithson made a holographic will containing provisions of immense importance to

JAMES SMITHSON. (From a painting by Johnes, 1816.)

American science. After providing for an annuity to one faithful old servant, and a benefaction to another, his will directed that the whole of the income arising from his property of every kind should be paid by his executors to his nephew, Henry James Hungerford; and should his nephew have children the whole of his property was bequeathed to them or their heirs after the death of their father. In case, however, the nephew should die without issue, Smithson provided as follows:

"I bequeath the whole of my property to the United States of America, to found at Washington, under the name of the Smith-

sonian Institution, an establishment for the increase and diffusion of knowledge among men."

The motives which prompted James Smithson to bequeath his fortune to the young republic across the seas are not certainly known. In the year 1818 (or 1819) he had some misunderstanding with the Royal Society, owing to their refusal to print one of his papers, and from that date he published exclusively in Thomson's Annals of Philosophy; it is said that prior to this difficulty he had intended to make the Royal Society his legatee. Having, however, abandoned that plan, he seems to have perceived with a prophetic eye the "germs of rising grandeur" in the free American nation, and to have felt a desire to promote the increase and diffusion of knowledge in the New World.

Whether he was more friendly to republicanism than to monarchy, as some have claimed, is not certain; at all events, by selecting the United States of America as the depository of his trust "he paid the highest compliment to its intelligence and integrity, and testified his confidence in republican institutions and his faith in their perpetuity."

In attempting to fathom the thoughts which directed Smithson's attention to the United States we are met by the surprising fact that he had not a single correspondent or scientific friend in America, nor did he write a line in any of his papers indicating appreciation of the republic.

Mr. Hungerford survived his uncle only six years, during which he received the benefits of the will; he led an aimless, roving life on the Continent, and died at Pisa, Italy, June 5, 1835, under the name of Eunice de la Batut, this being the surname of his stepfather, a Frenchman whom Hungerford's mother had married. By this death the United States became entitled to the estate. The first intimation received by the Government to this effect arrived in a communication dated July 28, 1835, from the *chargé d'affaires* of the United States at London to the Secretary of State, transmitting a letter from the firm of attorneys who represented the bankers holding the estate in trust. The estate was estimated at £100,000. In December, President Andrew Jackson sent to Congress a message setting forth the facts in the case and asking for authority to accept the trust; in July, Congress passed an act authorizing the President to appoint an agent to prosecute in the Court of Chancery the right of the United States to the legacy. This simple measure was not, however, secured without great difficulty, being opposed by several active Congressmen. Mr. W. C. Preston, of South Carolina, thought the donation had been made partly with a view to immortalize the donor, and it was "too cheap a way of conferring immortality"; and Mr. John C. Calhoun, of the same State, was of the opinion that it was be-

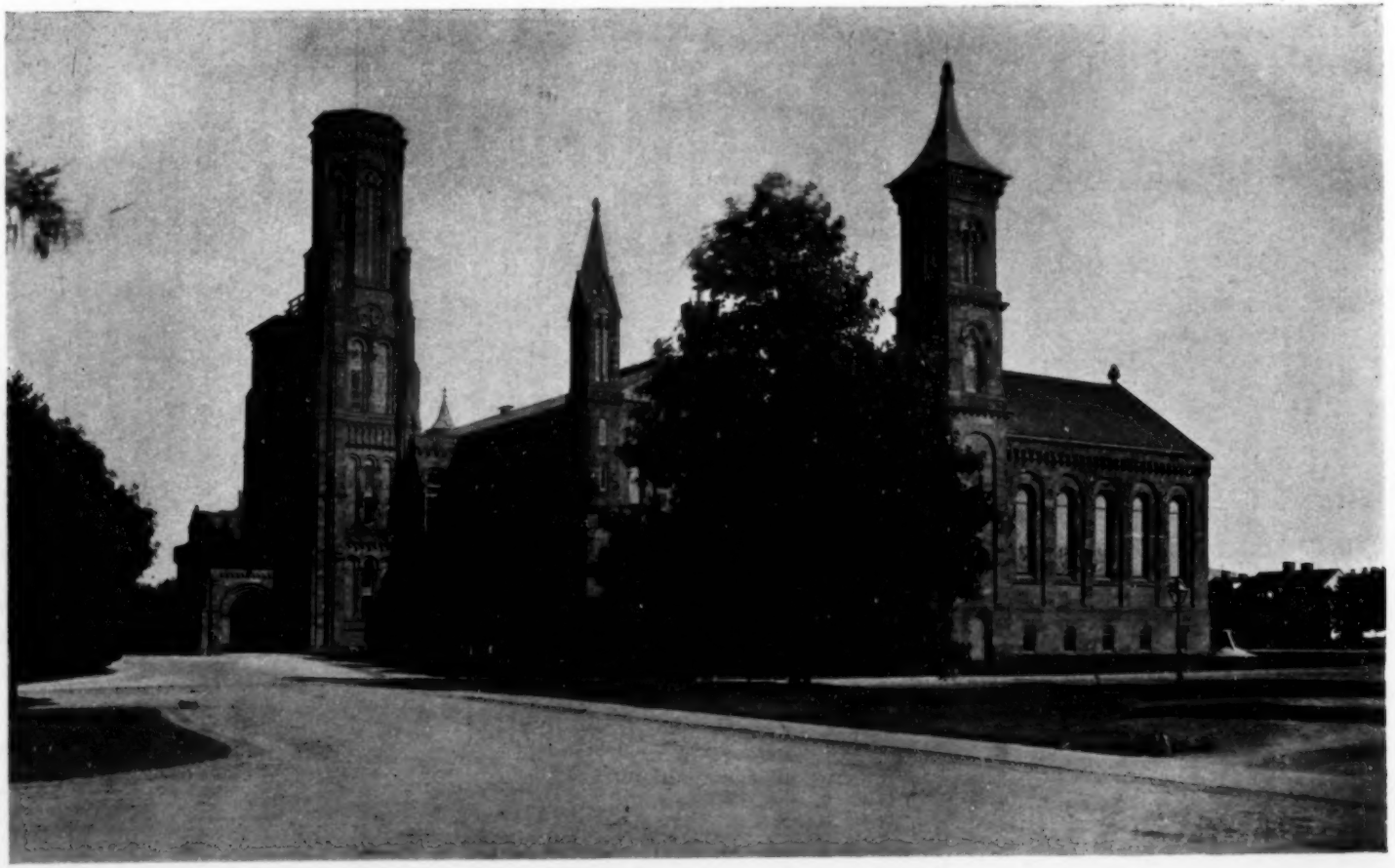
neath the dignity of the United States to receive presents of this kind from any one. The bill was, however, supported by the Committee of the Judiciary, to which the matter had been referred, and advocated by Mr. James Buchanan, of Pennsylvania, Mr. Robert J. Walker, of Mississippi, and Mr. John Davis, of Massachusetts.

Under this act President Jackson appointed the Hon. Richard Rush, of Pennsylvania, agent to prosecute the claims of the United States. The selection of Mr. Rush was a very happy one: he had been Comptroller of the Treasury, Attorney-General, minister to England, and minister to France. He displayed integrity and ability, and a persistence which accomplished the end in view with unexampled dispatch. Beyond the usual delays incident to court procedure, Mr. Rush met with no difficulties save one. Madame Théodore de la Batut, the mother of Mr. Hungerford, presented a claim for a life interest in the estate of Smithson; and to expedite matters Mr. Rush agreed to a compromise, granting an annuity, which she enjoyed until her death in 1861.* As soon as the securities were transferred to Mr. Rush, he converted them into gold and shipped it to New York on the Mediator; accompanying the treasure were three boxes containing the personal effects of the testator, including his collection of minerals, library, etc. The money arising from the Smithson bequest was at first invested in State stocks, and on December 10, 1838, President Martin Van Buren announced to Congress the receipt and disposition of the legacy of James Smithson. In 1841, Arkansas having failed to pay interest, through the efforts of Hon. J. Q. Adams the funds were transferred to the Treasury of the United States, to bear interest at six per cent per annum.

JOSEPH HENRY.

Three years had been consumed in securing the legacy, and seven and a half years more were destined to pass before Congress

* The principal retained in England to meet this annuity was paid over to the Smithsonian Institution in 1864. This residuary legacy amounted to $26,210 (gold).



SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

carried out the wishes of the testator by creating the Smithsonian Institution. To analyze the legislation during this period, to describe the many extraordinary schemes proposed, to merely name the Congressmen who were active in the prolonged discussion, would occupy more space than can be given to this entire article. Presidents Van Buren, Harrison, Tyler, and Polk came and went, each urging Congress to action, but the legislators suffered from the "embarrassment of riches" in a new sense. Among the plans prominently brought forward and considered at length were the following: Senator John Quincy Adams advocated an astronomical observatory; Senator Asher Robbins, of Rhode Island, favored the establishment of a National University; Senator Benjamin Tappan, of Ohio, proposed a botanical garden and an agricultural farm; Senator Rufus Choate, of Massachusetts, urged a grand library; Robert Dale Owen, of Indiana, preferred a normal school with lectureships on scientific subjects; Mr. Isaac H. Morse, of Louisiana, wanted the prizes awarded for the best written essay on ten subjects; and some legislators, wise in their own conceit, opposed every plan suggested. Mr. George W. Jones, of Tennessee, proposed that the whole fund be returned to any heirs at law or next of kin of James Smithson; and a similar disposition of the fund was advocated by Andrew Johnson, of Tennessee, and Mr. A. D. Sims, of South Carolina. It is interesting, in the light of later national events, to note the names of some of those who took part in these discussions: we find side by side the names of Jefferson Davis and Hannibal Hamlin, Andrew Johnson and Alexander H. Stephens, Howell Cobb and Stephen A. Douglas.

Meanwhile memorials from persons and institutions outside of Congress poured in, urging expedition, advocating particular bills and suggesting new plans. At least two societies of citizens sought to gain control of the magnificent fund which Congress was so slow in appropriating; the Agricultural Society of the United States, formed in the District of Columbia, memorialized Congress to apply the Smithsonian fund to its objects; and the National Institution for the Promotion of Science, organized in 1840 by representative men in Washington, sought union with or control of the embryonic establishment bearing Smithson's name. Dr. G. Brown Goode, in his Genesis of the United States National Museum (Report of the United States National Museum, 1891), points out that the President of this National Institution, Joel R. Poinsett, of South Carolina (Secretary of the Navy in 1840), deserves credit for introducing the feature of a national museum into the scheme for the Smithsonian Institution. Indeed, the organization of the Smithsonian Institution finally adopted bears marked resemblance to that of the National Institution both as regards the cast of officers and the objects of the establishment.

But all attempts to merge the interests of the two bodies failed, partly owing to objections to placing the management of the new institution in the hands of a private corporation; meanwhile the National Institution changed its name to National Institute, but after a flourishing existence of five years it lost its power.

Although much deprecated at the time, the slowness with which Congress acted in disposing of Smithson's legacy had its advantages: weak schemes were exposed, public opinion was educated, and the judgment of Congress itself was elevated by the prolonged discussions. The broad provisions of the will, open to the charge of vagueness, gave scope to the variety of views we have named and furnished ground for the delay. It is interesting to note that the act creating the Smithsonian Institution, adopted August 10, 1846, embodies nearly all the best features of the numerous schemes proposed during the ten years which had elapsed.

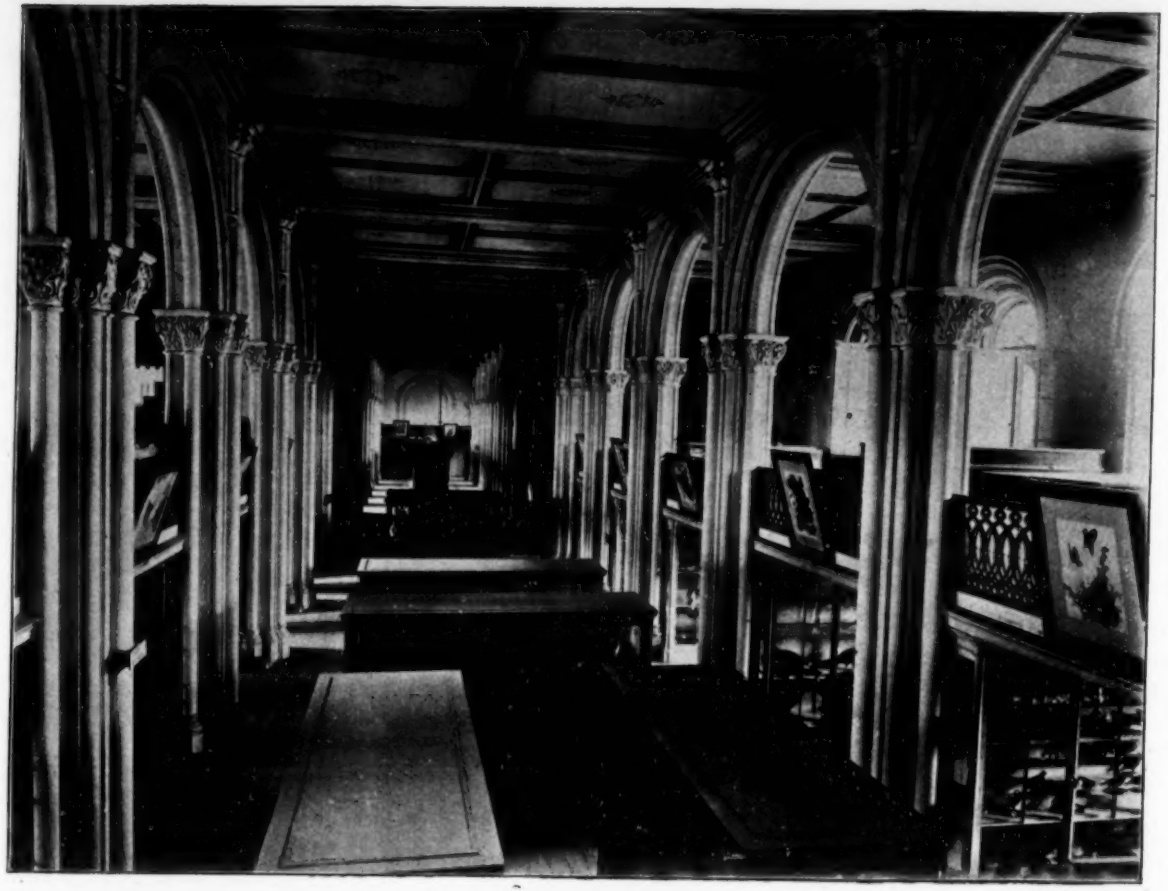
The act of incorporation was the work of many minds and to some extent a compromise; no one person should receive credit for its provisions, but mention should be made of Senator Benjamin Tappan, Robert Dale Owen, and William J. Hough, who drew up the bill eventually agreed upon. Stripped of legal verbiage and condensed, the bill is as follows:

TITLE.—A bill to establish the "Smithsonian Institution" for the increase and diffusion of knowledge among men.

Preamble: Rehearses the facts as to Smithson's bequest and the acceptance by the United States, and directs that the President and Vice-President of the United States, the Secretary of State, the Secretary of the Treasury, the Secretary of War, the Secretary of the Navy, the Postmaster-General, the Attorney-General, the Chief Justice, and the Commissioner of the Patent Office of the United States, and the Mayor of the city of Washington, during the time for which they shall hold their respective offices, and such other persons as they may elect honorary members, be constituted an "establishment" by the name of the Smithsonian Institution.

Section 2 provides for investment of the Smithson fund and payment of the interest thereon; also appropriates a sum for erection of a suitable building.

Section 3 provides that the business of said institution shall be conducted at the city of Washington by a Board of Regents to be composed of the Vice-President of the United States, the Chief Justice, and the Mayor of the city of Washington, together with three members of the Senate and three members of the House of Representatives, and six other persons, two of whom shall be members of the National Institute. The act then provides for the manner of appointment, the time of service, the filling of vacancies, the election of a Chancellor and Secretary by the Board of



SMITHSONIAN INSTITUTION—INTERIOR.

Regents and of an executive committee, as well as for the payment of money needed for conducting the institution; also, an annual report to be submitted to Congress.

Section 4 provides for the selection of a suitable site for a building.

Section 5 provides for the erection of a building of plain and durable materials, of sufficient size for rooms to contain objects of natural history, including a geological and mineralogical cabinet, a chemical laboratory, a library, a gallery of art, and the necessary lecture rooms; also provides for the expense of this building.

Section 6 enacts that in proportion as suitable arrangements can be made for their reception all objects of art and of foreign and curious research, and all objects of natural history, plants, geological and mineralogical specimens, belonging or hereafter to belong to the United States which may be in the city of Washington shall be arranged as best to facilitate their examination and study in the building to be erected; also new specimens to be so arranged; also minerals, books, and other property of James Smithson to be preserved in the institution.

Section 7 enacts that the Secretary of the Board of Regents shall take charge of the building and contents, shall discharge the duties of librarian and of keeper of the museum, and may employ assistants, and provides for their compensation.

Section 8 provides for meetings at which the President or Vice-President of the United States shall preside, and appropriates a sum not exceeding twenty-five thousand dollars annually for the formation of a library.

Section 9 enacts that moneys accrued as interest upon the fund, not herein appropriated, may be disposed of by the Board of Regents as they direct.

Section 10 enacts that one copy of all copyrighted books, engravings, maps, etc., shall be sent to the Librarian of the Smithsonian Institution, and one to the Librarian of Congress.

Section 11 gives to Congress the right to amend any of the provisions of this act.

This act was signed by President James K. Polk, August 10, 1846. It embodies the features of a national museum, a library, with provisions for copyrighted books, an art gallery, and lecture rooms, presumably for scientific courses though no special provision for them is made. It places the executive work in the hands of a Secretary, and the general oversight with care of finances in the power of a Board of Regents, which board includes the highest officials in the Government of the United States.

The opponents of this bill, though defeated, still endeavored to change its character. Eighteen months after its passage, Andrew Johnson, of Tennessee, introduced a bill to change the Smith-

sonian Institution to "Washington University, for the Benefit of Indigent Children of the District of Columbia," and spoke in favor of remodeling the entire plan so as to convert the institution into a university to include the manual-labor feature, mechanic arts, and agriculture. Mr. Embree wanted at the same time to graft upon the institution a department for collecting and arranging information on agriculture, common-school education, political economy, and the useful arts and sciences, which information shall be published and circulated gratuitously among the people.

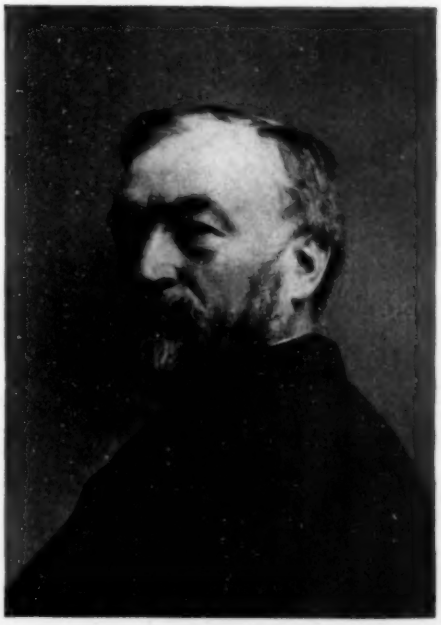
SPENCER F. BAIRD.

These attempts to tinker with the act of incorporation received their quietus on August 8, 1848, when the House of Representatives adopted a resolution to the effect that it is inexpedient to change and modify the act in the manner proposed. In 1878, and again in 1894, the act of incorporation was revised and somewhat simplified; the two Regents were no longer to be chosen from members of the National Institute, which meanwhile had died, and other slight changes were made.

Congress having appointed Regents, they organized by electing a Chancellor and temporary secretary. The act of incorporation placed great responsibilities in the secretary's office, and the Regents felt that the advancement of the proper interests of the trust made it essential that the Secretary of the Smithsonian Institution should be a man possessing weight of character and a high grade of talent; that he also possess eminent scientific and general acquirements; that he be capable of advancing science and promoting letters by original search and effort, and well qualified to act as a respected channel of communication between the institution and scientific and literary individuals in this and foreign countries. To this important position the Regents invited Prof. Joseph Henry, of the College of New Jersey, widely known in both hemispheres by his splendid discoveries in electro-magnetism and universally respected as a man by all who knew him. His acceptance of the secretaryship was a most fortunate event for the institution, insuring its high scientific standard, its wise

and economical administration, and its superior reputation at home and abroad. Henry's Programme of Organization, presented to the Board of Regents December 8, 1847, is a model of skillful analytical statement, proposing plans for the increase of knowledge and its diffusion among men; in it he laid down broad lines of action and established the foundations on which the existing edifice stands. Henry devoted the rest of his life, thirty-three years, to the development of this programme, and the institution owes to him an everlasting debt of gratitude for his enlightened, pure, and able administration of the trust.

After the plans of Mr. James Renwick, Jr., for a Norman building, had been accepted, its erection in the Mall was conducted slowly, being completed in 1855, at an expense of about three hundred and fourteen thousand dollars. Meanwhile prudent economy in expenditures enabled Henry to add one hundred and fifty thousand dollars of accrued interest to the original fund. A library was begun by exchange and purchase, and materials for a museum collected and housed. Besides these interests, the institution adopted the plan of promoting original research by assisting men of science in their labors; at the same time series of investigation were instituted, explorations conducted, and the results of all these endeavors were published and distributed to all the learned societies and important libraries throughout the world.



S. P. Langley.

Whenever a man was found capable of adding to the sum of human knowledge, the institution assisted him by supplying books not otherwise attainable, instruments of research, specimens of materials, and objects under investigation, and in some instances special grants of money were made for personal expenses. The specimens in all branches of natural history were not confined to the glass cases of the museum, but freely loaned to men engaged in special lines of research; and if the specimens required were not on hand, the institution undertook to obtain and to supply them, the only return asked for being

that full credit be given to the name of Smithson. This liberal policy has never been discontinued.

The institution established systematic meteorological observations, it instituted the first telegraphic weather service, published meteorological tables and charts, and became, in fact, the parent of the present Weather Bureau.

The institution early adopted a policy of doing nothing which could be accomplished as well by other means, and of relinquishing undertakings causing a draft upon its finances so soon as other bodies, or the Government, should agree to take them in charge. In pursuance of this wise plan the Secretary and the Regents induced Congress from time to time to make separate appropriations from the public Treasury in support of the National Museum, and of certain branches of work directly ordered by the Government itself. The library soon outgrew its limited quarters, and in 1866 was deposited in the Library of Congress, at a great saving of expense. The meteorological service was likewise transferred in 1874 to the Signal Corps of the United States Army.

For many years the institution conducted explorations in regard to the ethnology of the Indians of North America, and this has developed into an important Bureau of Ethnology, supported by Government appropriations, yet controlled by the Smithsonian.

The botanical collection was transferred to the Department of Agriculture, and the osteological specimens were placed in the Army Medical Museum.

The Smithsonian has been exceedingly fortunate in its executive officers. After the death of Henry, in 1878, Prof. Spencer F. Baird, the eminent naturalist, was called to the secretaryship. He had been United States Commissioner of Fishes for seven years and Assistant Secretary of the Smithsonian for twenty-eight years, and thus brought to the post wide experience as well as administrative ability. Under his care the National Museum was especially augmented, and the publications were issued uniformly on the lines laid down by his predecessor. Of his distinguished services to science we can not here take note; we merely quote two paragraphs from the resolutions adopted by the Board of Regents, November 18, 1887, on the occasion of his death:

"*Resolved*, That the cultivators of science both in this country and abroad have to deplore the loss of a veteran and distinguished naturalist, who was from early years a sedulous and successful investigator, whose native gifts and whose experience in systematic biologic work served in no small degree to adapt him to the administrative duties which filled the later years of his life, but whose knowledge and whose interest in science widened and deepened as the opportunities for investigation lessened, and who

accordingly used his best endeavors to promote the researches of his fellow-naturalists in every part of the world.

"*Resolved*, That his kindly disposition, equable temper, singleness of aim, and unsullied purity of motive, along with his facile mastery of affairs, greatly endeared him to his subordinates, secured to him the confidence and trust of those whose influence he sought for the advancement of the interests he had at heart, and won the high regard and warm affection of those who, like the members of this board, were officially and intimately associated with him."

Prof. Baird was succeeded in the office of Secretary by the present incumbent, Prof. Samuel P. Langley, LL. D., known to the scientific world by his masterly researches in solar physics. Under his administration the Smithsonian continues its prosperity with undiminished vigor.

In a second article we shall consider the present status and many activities of this noble institution.

PRINCIPLES OF TAXATION.

By DAVID A. WELLS, LL. D., D. C. L.,
CORRESPONDANT DE L'INSTITUT DE FRANCE, ETC.

I.—THE COMPARATIVELY RECENT TAX EXPERIENCES OF THE FEDERAL GOVERNMENT OF THE UNITED STATES. PART II.

WITH the close of the war a marked change speedily occurred, in the nature of discontent, in the temper of the people in respect to taxation. But this discontent at the outset was restricted almost exclusively to the so-called "internal revenue taxes," and extended in little or no degree to the war taxes imposed on imports; which last, so long as the internal revenue taxes continued to be levied upon every manufactured product, and also upon the separate constituents of such product, were not only wholly justifiable, but absolutely necessary, if the fiscal burdens of the war between the domestic producers and their foreign competitors were to be equalized. In some instances, through oversight or neglect, the tariff taxation was made actually less upon the imported article than was the internal taxation on the domestic product manufactured from it; one illustration of which was, that the charges imposed on the import of Manilla rope were fifty-six dollars per ton, while the internal taxes on the rope manufactured in the United States from the Manilla fiber ranged from forty-eight to seventy-three dollars per ton.

It soon became evident that the country *could* not endure for any great length of time the war system of taxation, and, furthermore, *would* not, when a return of peace had made its continu-

ance unnecessary.* And, pending its modification for the purpose of reduction, a desire to evade the payment of taxes everywhere manifested itself, until it seemed at one time as if the whole country and the Government itself were becoming corrupted and demoralized. For example, the revenue receipts from the income tax, without any change in the law, declined from $72,982,000 in 1866 to $66,014,000 in 1867; and those from a uniform tax on distilled spirits, from about $29,000,000 in 1867 to a little in excess of $14,000,000 in 1868.

It was under such circumstances that the Revenue Commission entered upon its prescribed duties. The work of investigation devolved mainly on its chairman, the second member being debarred by age and feeble health from any active exertion; while the third assumed from the outset that the best and most feasible way of meeting the financial difficulties of the situation was to abandon the "whole system" (of existing taxation) "in the shortest time consistent with the general interests of the country," and, by an amendment to the Federal Constitution, authorize and require the Federal Government to levy "a duty, payable in lawful money, of one per centum per annum" on the income of all interest-bearing indebtedness issued by the United States and payable in lawful money; and "a duty, payable in specie, of seven tenths of one per centum on the principal of all indebtedness of the United States, which shall belong to any person or corporation, and the interest on which may be payable in specie." He was also of the opinion that such taxes on the income or principal of the indebtedness of the United States, should be "in addition to any ordinary duty or tax equally imposed upon all incomes, or directly upon all personal and real property within the United States subject to taxation."

A subsequent report to this effect was not received with any marked disfavor by the general public, and had the indorsement of not a few leading American bankers and capitalists. As the average annual rate of interest accruing on the market price of the gold bonds issued by the United States from January, 1862, to January, 1866, was 8·82 per cent, and on investments in the debt of the United States payable in lawful money, from 1863 to 1866, was 10·68 per cent, the proposition to levy a tax of one per cent on the

* The imperative necessity of a speedy abatement of the internal revenue taxes after the termination of the war finds striking illustration in the following examples of actual experience. Thus the tax of six per cent, levied and collected during the fiscal year 1864–'65, on the value of the products of the woolen industry in Massachusetts alone ($48,430,671) was equivalent to nearly twenty per cent on the whole capital ($14,735,671) invested in this business; while the tax on the value of boots and shoes manufactured in the same State during the same year ($52,915,243) was equal to thirty per cent on the whole capital employed ($10,067,474).

income or principal of the same did not appear unreasonable, especially in the case where *no* exemption from taxation was stipulated in the contract for these issues. But neither the author of the report nor its indorsers could have anticipated that within little more than five years after it was submitted to Congress, the Federal Government could have borrowed $185,000,000 at four and a half per cent interest; and that twenty-five years afterward would be able to renew a debt of $25,364,500 at two per cent per annum, or at a rate fifty per cent less than loans on the best corporate or private securities would have at the same time commanded.

The method of prosecuting the work contemplated by Congress of the Commission was at the outset a matter of no little embarrassment. There was practically no material or basis to work on, except the bare statutes authorizing war taxes, and no official collection of these was published by the Government until two years after the commencement of the war. There was no bureau of statistics in the Treasury, and in this department of the Government the officials to whom was assigned the duty of collecting and publishing reliable data relative to the trade and commerce of the country were untrained. No full and reliable statistics concerning any branch of trade or industry in the United States, with possibly a very few exceptions, were then, or ever had been, available. The Treasury received returns of the aggregate of revenue collected and the sources whence it was derived; but these returns were rarely, if ever, accompanied by any suggestions, derived from administrative experience, of any value. The commercial returns from the customs were hardly worth the paper on which they were written. Thus, for example, when the duty on the importation of coffee came up for consideration as a source of revenue, the value of the coffee imported during the fiscal year 1864–'65 was officially returned at ten and a half cents per pound, while its average invoice price, according to the trade of New York for the same period, was not less than thirteen cents. Again, according to the Treasury statement, the aggregate imports of coffee for the same year, were 104,316,581 pounds. Of this amount 82,353,000 pounds, which were retained for domestic consumption, had a returned value of only six and four tenths cents per pound, while the value of 21,962,000 pounds of the same imports which were exported during the same year, had the extraordinary value of nearly twenty-five cents per pound. For the year 1863 the Treasury reported an aggregate import of spirits distilled from grain of 1,064,576 gallons, but of this quantity only 45,393 gallons were entered at the ports of Boston, New York, Philadelphia, Baltimore, and San Francisco, leaving an inferential import of 1,019,183 gallons at other ports of the loyal States that practically had no foreign commerce.

In the Bureau of Internal Revenue a better system prevailed; but this department of the Treasury being always overburdened with work, and its service largely rendered by assessors and collectors who were destitute of business training, contributed but little in the way of deductions from experience. It had, moreover, at one time as its head an official who subsequently in a higher position refused to allow data to be collected in respect to certain taxes, on the ground that the less the people knew about such matters the better it was for the Treasury.

Another great source of difficulty experienced by the Commission in conducting investigations with a view of arriving at any correct estimates of the prospective revenue of the country was the abnormal condition of every branch of trade and industry after 1861, due primarily to the war disturbances, and next to the frequent alterations in the rates of taxation. Every advance made in tariff, or internal revenue taxes, was anticipated to such an extent by importers, manufacturers, dealers, and speculators that the Government could not fairly test the capacity of any one of its great and legitimate sources of revenue. Thus, for example, the almost incredible profits made by reason of anticipation of the large and repeated advances in the taxes on distilled spirits have already been pointed out. Of cigars, in like manner, it was estimated that above eighty millions had been made and stored at one time in the city of New York alone, in anticipation of a higher tax; and in the case of the comparatively insignificant article of matches, on which the tax was only one cent per bunch, the stock accumulated in anticipation of an advance of tax was so large that it was not entirely exhausted for a subsequent period of three years.

In the absence of any specific instructions, either from Congress or the Secretary of the Treasury, it was difficult for the commission to form an opinion as to the best method of entering upon the comprehension and reform of a scheme of taxation which embraced almost every form of tax that the ingenuity of man could devise, and with an incidence on almost every form of property, business, profession, or occupation that was capable of yielding to the state a revenue. The conclusion arrived at, after no little consideration, involved a complete abandonment of any idea of endeavoring to enter upon and comprehend the whole field of inquiry at the outset; and in its place, and in accordance with the maxim attributed to Emerson, that the eye sees only what it brings to itself to see, it was determined to take up and study specifically the sources of public revenue in the order of their importance; and give no attention to any other subject, or attempt to theorize, until everything that domestic experience or the experience of other countries could teach concerning them had been

made familiar. In practically carrying out this idea, the chairman of the commission put himself in direct and frequent communication with revenue officials and representative business men from every section of the country; and availing himself of the power to take testimony, under oath, he often came into the possession of important facts which in daily life had been screened from the eye of the public. The result was that the commission presented to Congress, in January, 1866, a report which gave for the first time a full, clear, and exact statement of the curious and complex scheme of internal and customs revenue that had been evolved, as it were, out of the financial necessities contingent on the prosecution of a gigantic war: which involved the raising by taxation during the war period (and exclusive of loans) of an aggregate of over $2,000,000,000, and a not infrequent daily disbursement (expenditure) of over two millions of dollars; and in addition to this feature the report contained special and elaborate exhibits on distilled spirits, fermented liquors, petroleum, cotton, tea, coffee, sugar, spices, proprietary articles, and patent medicines as sources of Government income, with estimates of the amount of revenue which the Treasury might annually expect if taxation at various rates on the same was to be continued; the whole being really the first practical attempt in the United States to gather and use national statistics for great national purposes.

On the termination by statute of the Revenue Commission, in January, 1866, its chairman was appointed to an office specially created by Congress, for a period of four years, with the title of "Special Commissioner of the Revenue" of the United States; and the duties of which were thus defined by statute:

"*He shall from time to time report through the Secretary of the Treasury to Congress, either in the form of bill or otherwise, such modifications of the rates of taxation, or of the methods of collecting the revenues, and such other facts pertaining to the trade, industry, commerce, or taxation of the country as he may find by actual observation of the law to be conducive to public interest.*"

In this office, and invested with large powers, its incumbent entered upon the work of co-operating with the appropriate committees of Congress—"Ways and Means" of the House and "Finance" of the Senate—in reconstructing the then existing and extraordinary system of the United States internal revenue; and under his initiation and supervision were originated almost all the reforms in this department of the Government that were considered or enacted by Congress between the close of the war and the year 1870; namely, the redrafting of nearly the whole body of complicated and often conflicting statutes; the reduction and final abolition of the taxes on crude products—especially cotton, salt, lumber, petroleum, and the metals—and most of the taxes on manufactures;

the creation of supervisory districts and the appointment of supervisors; the origination of the use of stamps for the collection of taxes on distilled spirits, fermented liquors, tobacco, and the sales of stockbrokers (the last in place of a general tax of one twentieth of one per cent on sales); and the creation and organization of the Bureau of Statistics as a branch of the national Treasury. These modifications brought the internal revenue duties within a reasonable compass, introduced systems where the want of it was working mischief, and by their ready application in administration reconciled the people to a maintenance of important sources of revenue and a continuance of taxes, which have by their stability and steady increase enabled the Government to meet financial exigencies otherwise awkward and dangerous. The service thus rendered met with recognition at the time both in and out of Congress, and was strongly indorsed by those most interested—the head of the Treasury and the industries taxed.*

The work of taking down the vast and complicated structure of internal taxation, which had been built up during the war, having been once seriously entered upon by Congress (in 1866), it was prosecuted so vigorously that in the comparatively short space of three years the aggregate annual receipts from such taxes were reduced from $310,906,000 in 1866 to $160,039,000 in 1869—a reduction of $150,865,000—and to $102,644,000 in 1872, a further reduction of $57,395,000; while the sources of revenue, the annual receipts from each one of which were specifically reported, were reduced from about two hundred and seventy-five in 1866 to nominally sixty-six in 1872; but practically to three—distilled spirits, fermented liquors, and tobacco—the receipts from which alone in 1893 were $150,865,000 as compared with $91,464,000 in 1872. It should, however, be noted that this remarkable increase of revenue, coincident with a large reduction in the number of taxed articles, was due mainly to an increase of consumption consequent upon an increase of population during the period under consideration (26,230,000) rather than to any

* "I do not believe that any man appointed by the Government in the civil war has done for his country more work, and more valuable work, than David A. Wells. Into the financial chaos resulting from the war he threw the whole weight of a strong, clear mind, guided by an honest heart, and he has done more, in my judgment, to bring order out of chaos than any one man in the United States."—(*Speech of General James A. Garfield, Member of Congress, United States House of Representatives, July 13, 1868.*)

"There are few of my official acts that I look upon with more satisfaction than the appointment of David A. Wells to be Revenue Commissioner. All the reports that were made by him exhibited the most careful, painstaking, and intelligent investigation. In clearness and accuracy of statement, and in logical force, they have not been surpassed on either side of the Atlantic. Their ability was admitted, even by those who disagreed with the *writer in his conclusions.*"—(*Men and Measures of Half a Century, by Hugh McCulloch, Secretary of the Treasury during the Administrations of Presidents Lincoln, Johnson, and Arthur.*)

increase in the rate of taxes imposed upon the remaining sources after 1872.

Of many other curious and instructive economic experiences, consequent upon the rapid and radical changes in the fiscal policy of the United States during the period under consideration, the following seem especially worthy of notice: The first abatement or repeal of internal taxation on various articles after the war—to the extent of about fifty millions in 1866—was not attended with any general and immediate reduction in the prices of the articles relieved, corresponding to the reduction of taxation, but with rather an increase of prices. The explanation of this circumstance was, that the continuance of the heavy war taxation, for a period after the extensive war demands of the Government for various commodities had ceased, had diminished their production to a point below what would have been the normal consumption of the country; and that, therefore, prices increased concurrently with the abatement of taxes and a renewal of demand. Such a result was, however, but temporary, and the condition of affairs was soon reversed. The supply of manufactured products quickly became equal to or exceeded demand. The price of products fell faster than the price of either labor or capital, and taxation, which formerly had been paid wholly from profit, now fell mainly upon capital. The general result was a year (1867) of great industrial and commercial depression.

The enlarged use of stamps as machinery for the collection of taxes, and their novel application to fermented liquors and distilled spirits, were attended with very striking results. In the case of fermented liquors (beer), it was established almost beyond doubt by the Revenue Commission that previous to 1866 the Government was defrauded of its legitimate revenue to an extent of forty per cent, involving an absolute annual loss of about $6,400,000. The adoption, with no little hesitation by Congress in 1866, of the principle, that the payment of the tax on this commodity should be effected by the purchase and affixing a stamp to each barrel sold and removed from the place of manufacture, with the additional requirement that the stamp should be canceled by the retailer or consumer at once, increased the revenue from $3,657,000 in 1865 to $5,115,000 in 1866—the year of first application—and to $5,819,000 in 1867; and ever since has proved most effective and satisfactory.

A recommendation to make use of stamps for the collection of taxes on tobacco was acceded to by Congress in respect to smoking tobacco and snuff, but was refused in respect to chewing tobacco, cigarettes, and cigars; in the latter case on the assumption that it was impracticable to affix an adhesive paper stamp on the body of a cigar, while the "trade," not long afterward, and at its own volition, demonstrated its entire feasibility. Had the recommen-

dation in this particular found favor, it would have resulted in an accretion of many millions to the national Treasury, a relief from espionage and other frictions to the trade, and a larger diminution of administrative expenditures both to the trade and the Government.

The experience of the Federal Government in its taxation of distilled spirits is extraordinary, and so replete with instruction to economists, moralists, and social reformers as to merit a more extended notice.

The product of distilled spirits in the United States for the year 1860, as returned by the census, was about 90,000,000 gallons. It would be an error to assume that all of this immense production of spirits was used for intoxicating purposes, or in the way of stimulants, inasmuch as the extreme cheapness of spirits or alcohol in the United States during the period under consideration occasioned their employment in large quantities for various industrial purposes; which uses were subsequently in a great degree discontinued when the price of spirits was enhanced from one hundred to one thousand per cent and upward by Federal taxation. For 1860–'61, the year preceding the war, the average price of proof spirits in Cincinnati was 14·40 cents per gallon.

From 1822 to 1862 distilled spirits, in common with all other domestic industrial products, were exempt from Federal taxation. In the latter year, under the necessity for revenue occasioned by the war, Congress imposed a tax of twenty cents per proof gallon on all distilled spirits of domestic production. This tax went into effect on the 1st of September, 1862, and continued in force until March, 1864. The total revenue derived from this source, including the receipts from licenses for rectifying, vending, and the like, for the fiscal year 1863, was $5,176,530. The receipts from the direct tax on the spirit itself was $3,229,990, indicating a domestic production of only 16,149,954 gallons as compared with a production of 90,000,000 gallons returned under the census of 1860, three years previous. The explanation of this result is to be found in the fact that a large amount of whisky was manufactured in anticipation of this low tax, and that there were doubtless some evasions of the tax after it was enacted—conditions that were repeated, as will be presently shown, in a greater degree on every occasion when an advance in the tax was enacted.

The tax of twenty cents continued in force until March 7, 1864, when the rate was advanced to sixty cents per gallon. The revenue accruing under these two rates for the year ending June 30, 1864, was $28,431,797, and the number of gallons returned as having been assessed was 85,295,393. The striking discrepancy between the number of gallons taxed in 1864 at twenty and sixty cents and the number taxed the previous year (1863) at twenty

cents again finds explanation in the fact that when it became evident to the distillers that the fiscal necessities of the Government would soon compel an advance in the tax upon their product, and that such increase would not be made applicable to stocks on hand on which the lower rates had been assessed and paid, they pushed their production to the uttermost in order that they might take advantage of the great increase in the market price of all spirits after the advanced rates had taken effect; all which anticipations were fully realized. Thus, of the 85,295,393 gallons on which the Internal Revenue Bureau assessed and collected the spirit tax for 1864—69,000,000 in excess of the product of the preceding year—at least 70,000,000 gallons were manufactured prior to the 7th of March and were released from Government control by the payment of the twenty-cent tax only; and as after the 7th of March, 1864, the market price of the greater part of this increased product, which had not been allowed to pass into consumption, was advanced in accordance with the advance in the tax—i. e., forty cents per gallon—it is clear that $28,000,000 at least were thus at once legislated into the pockets of the distillers and speculators concerned.

Again, immediately after the imposition of the sixty-cent rate in March, 1864, nearly all the distilleries once more suspended operation; the country was acknowledged to be overstocked with tax-paid whisky, and the Government almost ceased to collect taxes upon its manufacture. In May, however, the project for a further increase in the rates began to be again agitated in Congress, and as soon as its realization became probable, all the distilleries speedily resumed operations. How great at that time was the capacity of the loyal States for production may be inferred from the circumstance that the number of distilleries in the country, which according to the census of 1860 was 1,138, had increased in 1864 to 2,415.

On the 1st of July, 1864, the tax was again advanced from sixty cents to a dollar and a half per gallon; and during that month the entire product of the country of which the revenue officials could take cognizance was only 697,099 gallons. How great a "stock on hand," the result of manufacturing under the twenty and sixty cent rates of tax, was carried over the 1st of July and experienced the advance of ninety cents per gallon in market price in consequence of the advance in the tax from sixty cents to a dollar and a half, can not be accurately known; but 60,000,000 gallons would certainly be a low estimate; and on this amount the profit that accrued to private interests was at least $50,000,000.

On the 1st of January, 1865 (the succeeding year), the tax was further advanced to two dollars per proof gallon, when all the operations above described were repeated, with all the benefits to private or speculative interests derived from former experiences,

and a consequent very large extension of the sphere of participants in the resulting profits.

In short, all the available evidence indicates that the profits realized by distillers, dealers, and speculators, through Congressional legislation having reference to the taxation of distilled spirits from July 1, 1862, to January 1, 1865—a period of two and a half years—and exclusive of any gains accruing from evasions of taxes, and with every allowance for overestimates, must have approximated $100,000,000.

After the establishment of the two-dollar rate on the 1st of January, 1865, there was again a period of inactivity on the part of those interested in the manufacture of distilled spirits. The stocks on hand, manufactured in anticipation of the advances in rates, were very large, and, the markets being over-supplied, there was little legitimate inducement for activity on the part of distillers. The profits realized or made prospectively certain had been, moreover, enormous, and no further advance in the rate of tax could be anticipated. Under such circumstances there was an apparent disposition on the part of manufacturers and speculators to wait and see what developments in legislation and business would follow the termination of the war in favor of the Union, which was then everywhere recognized as approximately certain. These developments were not long in manifesting themselves.

The tax of two dollars per proof gallon (amounting to more than 1,500 per cent on the average cost of production) and the enormous profits contingent upon the evasion of the law, coupled with the abundant opportunity which the law through its imperfections, and the vast territorial area of the country, offered for evasion, created a temptation which it was impossible for human nature as ordinarily constituted to resist. This view was taken by the Revenue Commission in a report to Congress through the Secretary of the Treasury in February, 1866; and the chairman of the commission, after a thorough investigation of the subject and the collection and presentation of a large amount of evidence, expressed the opinion that the attempt to collect a two-dollar tax was utterly impracticable, and that the longer it was retained the less would be the revenue and the greater the corruption. He also coupled this opinion with a recommendation that a tax of fifty cents per proof gallon, with a judicious license system for rectifiers and dealers, be substituted as likely to be most productive of revenue and most efficient for the prevention of illicit distilling and other revenue evasions.

This report, although attracting much attention by reason of the singular revenue experiences of the preceding four years which it detailed (and which the public, with its thought concentrated on the results of the war, had in a great degree overlooked),

found little favor in respect to its recommendation of tax abatement; and the general sentiment both in and out of Congress was expressed by a leading member of the House of Representatives, who publicly declared that "he was not ready to admit that the nation which had put down such a great rebellion at the cost of so much blood and treasure could not collect a tax of two dollars a gallon on whisky."* The two-dollar tax therefore was allowed to remain in force, and the tax experiences of the United States from 1865 to 1869 inclusive, in respect to spirits, viewed from the standpoint of finance, economics, and morals, constitute one of the most interesting, instructive, and disgraceful chapters in its history. Under the strong temptations of large and almost certain gains, men rushed into schemes for defrauding the revenue with the zeal of enthusiasts for new gold fields; and the ingenuity of the American people has never had more striking illustrations than was offered in their devices for evading the tax and providing for security against detection and punishment in so doing. The parties concerned in these transactions also showed throughout more ability than Congress and more shrewdness than the revenue department of the national Treasury; and at a later period a Secretary of the Treasury was obliged to resort to the use of a cipher for his telegraphic and written correspondence, in order to prevent the frustration of his plans for the enforcement of the laws by Treasury officials who were specially charged with their administration. The evidence in part confirmatory of these statements is as follows:

The revenue directly collected during the fiscal year 1866 (the first full year under the two-dollar tax) from spirits distilled from other materials than fruits† was $29,198,000, and in 1867 $28,296,000, indicating an annual product respectively of 14,599,000 and 14,148,000 gallons. But during the succeeding year, 1868, with no apparent reason for any diminution in the national production and consumption of spirits, and with no increase, but rather a diminution, in the volume of imported spirits, the total direct revenue from the same source was but $13,419,092, indicating a production of only 6,709,546 gallons.

As the consumption of distilled spirits in this latter year was probably not less than 50,000,000 gallons, and as out of this the Government collected a tax upon less than 7,000,000, the sale of the difference at the current market rates of the year, less the

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* Of the then leading members of Congress, only two—the late President Garfield and Hon. W. B. Allison, both members of the House of Representatives—indorsed the recommendation of the commissioner at the outset.

† The revenue derived from the taxation of spirits distilled from fruits has always been comparatively small: $283,499 in 1866; $868,145 in 1867.

average cost of production (even if estimated as high as thirty cents in currency), must have returned to the credit of corruption a sum approximating $80,000,000.

Another curious feature developed was, that the number of distilleries in the country increased just in proportion as the tax on spirits was augmented; the inducement of the great profit to be obtained from a high rate of tax—the two-dollar rate especially—undoubtedly tempting many to engage in illicit manufacturing who would be unwilling to do so with a certainty of realizing a much smaller rate of profit. Of many curious examples of evidence to this effect, the following reference is particularly interesting: In the eighth collection district of the State of New York there was, before the internal revenue law went into operation in 1862, but one distillery. When the first tax of twenty cents per gallon was imposed, six additional distilleries were started. Under the sixty-cent rate about one dozen were in operation. But this number, under the two-dollar tax, increased to about forty. Furthermore, the tax collected at one distillery in the same district in one month in 1864, under the sixty-cent tax, was one third more than was paid in the aggregate by thirty distilleries in the district in the eight months succeeding November, 1865, when the tax was two dollars; or, to state it differently, one distillery in one month, in 1864, paid $58,819, at sixty cents per gallon, while thirty distilleries in eight months in 1866 paid, at two dollars per gallon, only $33,664. For the entire country the number of licensed distilleries, which in 1864 was 2,415, was returned in 1868 at 4,721—an increase of double in the short space of four years.

Thus confronted with positive evidence of astounding frauds which the Government that put down a great rebellion virtually confessed that it could not prevent, and a steadily diminishing revenue from what ought to have been a steadily increasing source, Congress finally became thoroughly alarmed, and, acceding to the recommendation of the Special Commissioner of the Revenue, reduced (in July, 1868) the direct tax on distilled spirits from two dollars to fifty cents per proof gallon.*

* The statement that the tax on distilled spirits was reduced from two dollars to fifty cents per gallon in 1868 has been criticised (see letter of United States Commissioner of Internal Revenue, embraced in report of the Secretary of the Treasury for 1893) as not in accordance with the statement that the tax imposed in the above-mentioned year was not fifty but seventy cents per gallon. The only warrant for such criticism to be found in the circumstance that the statute of 1868, which fixed the direct tax on spirits at fifty cents per gallon, and none other, also contained separate and independent provisions imposing licenses, taxes on capacity of stills, and on the sales of dealers, with some modification of the fees of gaugers and storekeepers; and that these additional assessments brought up the tax from fifty to seventy cents per gallon. But this reasoning overlooked two essential features of the act, namely, that the direct tax on every proof gallon must be paid by the distiller, owner, or other person having possession thereof, before removal from the distil-

The results of such legislation were immediate and most remarkable. Illicit distillation practically ceased the very hour the new law came into operation. Industry and the arts experienced a large measure of benefit from the reduction in the cost of spirits; while the Government collected during the second year of the continuance of the new rate and system, with comparatively little friction, *three* dollars for every one that was obtained during the last year of the two-dollar tax. Assuming, as is warranted, that with a continuance of the two-dollar tax there would have been no increase in the revenue from distilled spirits beyond what accrued in 1868—the last year of its existence—the gain in revenue to the Government in the succeeding two years from the adoption of the fifty-cent rate was at least sixty millions of dollars. Furthermore, but for the injudicious but popular speech (to which reference has been made) at an opportune moment in committee by a statesman who had bestowed but little attention to the subject, the reduction of the tax from two dollars to fifty cents per proof gallon would undoubtedly have been anticipated by a year, and attended with like gainful results. The cost of this speech, therefore, to the national Treasury may be rightfully estimated as at least ten millions of dollars. The record of this chapter of the tax experience of the United States also forcibly illustrates the impolicy and disaster of embodying any fiscal policy in statute enactments without a previous study and full comprehension of all the elements involved.

For the first but incomplete fiscal year (1869) under the fifty-cent tax the revenue increased to the extent of nearly $20,000,000, or from $14,290,000 in 1868 to $33,735,000 in 1869; or, including all taxes on the manufacture and sale of distilled spirits, licenses, etc., from $18,655,000 in 1868 to $45,071,000 in 1869. During the next fiscal year (1870) there was a further increase in the total revenue of $10,534,864, or from $45,071,000 in 1869 to $55,606,094 in 1870.

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lery or warehouse; and next, that none of the indirect and supplementary taxes could be assessed or collected until after the direct tax (of fifty cents) had been paid; the license taxes, for example, varying according to the product of the distillery, and payable in block, at different specified times. A great and novel object here sought for, namely, of diminishing the inducements to fraud, by directing the collection of the direct and supplementary taxes on spirits as respects persons, places, and times, was fully achieved; for, although the aggregate of the direct and indirect tax on spirits undoubtedly increased their cost to their final consumers, the largest possible gain to the distiller from the evasion of the separate and comparatively small indirect taxes which contributed to this increase, even apart from the risks of punishment involved, were too small to be worthy of his attention. The effort, therefore, to attempt to minimize by sophistical reasoning the remarkable effect of the reduction in 1868 of the tax on distilled spirits to fifty cents has no rightful claim for consideration, and unquestionably was prompted by a very general but unwise public sentiment, that it is desirable always to subject the manufacture and sale of spirituous and fermented liquors to exceptionally high rates of taxation.

The specific tax on distilled spirits of fifty cents per proof gallon remained in force from July, 1868, to August, 1872, a period of a little more than four years. During this period the tax was assessed and collected on an average production of 67,175,822 proof gallons per annum, yielding an average annual revenue of about $34,000,000, and indicating an average annual consumption for all purposes of the country of about 1·65 proof gallons *per capita*. For the period of four years immediately preceding the fiscal year 1869, under a tax of two dollars per proof gallon for three years, and a dollar and a half and two dollars for one year (1865), the tax was assessed and collected on an average annual production of only about 13,300,000 proof gallons per annum, yielding an average annual revenue of about $21,727,000, and indicating an average annual consumption of only about 0·38 proof gallon *per capita*.

But, notwithstanding these satisfactory results, the law authorizing the reduction of the tax from two dollars to fifty cents per proof gallon had hardly become operative when agitation commenced for its repeal or modification. Speculators had the idea that the old scheme of increasing the tax after a little lapse of time, without making the increase applicable to stocks on hand, was, with its gainful prospects, again within the range of possibilities; while very many extreme advocates of temperance, untaught by and caring nothing for the record of recent experience, were inclined to regard the new and comparatively low tax as impolitic and in the light of the removal of a barrier against the spread of intemperance. These and other arguments proved sufficiently potent, and in June, 1872, Congress, by an act which took effect in the following August, increased the gallon tax to seventy cents, and subsequently, in March, 1875, raised the rate to ninety cents per gallon, and in August, 1894, further increased it to a dollar and ten cents, the present rate.

It is not necessary to recall that the experiences which were attendant upon every advance of the tax on spirits from its first imposition in 1862 to 1868 were repeated subsequently in 1872 and in 1875, when the increased rates of seventy and ninety cents were respectively enacted; those of the latter date being remarkable from the circumstance that the frauds upon the revenue, which were enormous, were more directly brought home to high officials of the Government than at any former period, and constitute a chapter in the history of government by the people which the people may well wish forgotten.

The above review of the experiences of the United States prior to 1869, in attempting to enforce the collection of an excessively high tax on the production and consumption of distilled spirits, is mainly valuable in this connection from the economic and moral

lessons deducible from it, which may in brief be summarized as follows:

Whenever a government imposes a tax on any product of industry so high as to sufficiently indemnify and reward an illicit or illegal production of the same, then such product will be illicitly or illegally manufactured; and when that point is reached, the losses and penalties consequent upon detection and conviction—no matter how great may be the one or how severe the other—will be counted in by the offenders as a part of the necessary expenses of their business; and the business, if forcibly suppressed in one locality, will inevitably be renewed and continued in some other. It is therefore matter of the first importance for every government in framing laws for the assessment and collection of taxes to endeavor to determine, not only for fiscal but also for moral purposes, when the maximum revenue point in the case of each tax is reached, and to recognize that in going beyond that point the government "overreaches" or cheats itself.

Obviously those who in the past have shaped the policy of the United States in respect to the taxation of distilled spirits for the purpose of revenue have, for the most part, never studied this aspect of the case or cared to encourage any one to do so; but, on the contrary, as has been somewhat humorously expressed, "they have held out to the citizen, on the one hand, a temptation to violate the law too great for human nature as ordinarily constituted to resist, and in the other writs for personal arrest and seizure of property, and, thus equipped, have announced themselves ready for business."

The data officially collected and reported by the Internal Revenue Department of the United States Treasury furnish the only reliable basis for obtaining approximately correct answers to the following questions: 1. To what extent, through a well-considered system of taxation, can the manufacture and sale of distilled spirits be made available as sources of national revenue? 2. What has been and is the probable *per capita* and aggregate annual consumption of this class of spirituous liquors by the people of the United States? The first of these questions is eminently pertinent to the legislator; the second, to the student and advocate of social reform.

The experience derived from the taxation of distilled spirits previous to 1869 by the Federal authorities was so unnatural and, as it were, spasmodic as to debar its use for the determination of any general or average conclusions, and limits inquiry to the results which followed in subsequent years (1870–1894), under lower and more rational rates of taxation, and a more efficient and intelligent fiscal administration. And for the purpose of making a clear exhibit of these, attention is asked to the following table (prepared

from official data), showing (1) the population of the country for each successive fiscal year from 1870 to 1894, inclusive; (2) the quantity of gallons of spirits annually taxed; (3) the average *per capita* consumption for each successive year; (4) the amount of revenue annually collected; (5) the average annual revenue, or tax *per capita*; (6) the annual tax per gallon; (7) the average tax per gallon.

Year ending June 30.	Population.*	Quantity taxed.	Quantity per capita.	Revenue.	Revenue per capita.	Tax per gallon.	Average tax per gallon.
		Gallons.	Gallons.	Dollars.	Dollars.	Cents.	Cents.
1870	38,558,371	78,490,198	2·03	39,245,099	1.02	.50	50
1871	39,555,000	62,314,628	1·58	31,157,314	.79	.50	50
1872	40,596,000	66,235,578	1·63	33,117,788	.82	.50	50
1873	41,677,000	65,911,141	1·58	43,131,064	1.03	.50 .70	65·14
1874	42,796,000	62,581,562	1·46	43,807,093	1.02	.70	70
1875	43,951,000	64,425,911	1·47	46,877,938	1.07	.70 .90	72·76
1876	45,137,000	58,512,693	1·30	51,390,490	1.14	.70 .90	88·58
1877	46,353,000	58,043,389	1·25	52,671,291	1.14	.70 .90	89·97
1878	47,598,000	50,704,189	1·07	45,626,533	.96	.70 .90	89·99
1879	48,866,000	53,025,175	1·09	47,709,464	.08	.50 .70 .90	89·98
1880	50,155,783	62,132,415	1·23	55,919,119	1.11	.70 .90	90
1881	51,316,000	69,127,206	1·34	62,214,127	1.24	.70 .90	90
1882	52,495,000	71,976,398	1·37	64,778,756	1.23	.70 .90	90
1883	53,693,000	76,762,063	1·43	69,085,856	1.22	.90	90
1884	54,911,000	79,616,901	1·45	71,655,211	1.30	.90	90
1885	56,148,000	69,158,025	1·23	62,242,221	1.23	.70 .90	90
1886	57,404,000	70,851,355	1·23	63,766,219	1.11	.90	90
1887	58,680,000	67,380,391	1·15	60,642,351	1.03	.90	90
1888	59,974,000	71,565,486	1·19	64,408,937	1.07	.90	90
1889	61,289,000	77,163,529	1·25	69,447,175	1.13	.90	90
1890	62,622,250	85,043,336	1·35	76,539,002	1.22	.90	90
1891	63,975,000	88,473,437	1·38	79,626,093	1.24	.90	90
1892	65,520,000	95,045,787	1·45	85,541,209	1.31	.90	90
1893	66,826,000	99,145,889	1·48	89,231,300	1.34	.90	90
1894	68,000,000	88,777,387	1·33	79,862,647	1.74	.90 1.10	

The first point of interest which an examination of the above table reveals is, that the average *per capita* consumption of tax-paid distilled spirits by the people of the United States during the years 1870, 1871, 1872, and 1873, under the tax of fifty cents per gallon, was greater than it has been at any subsequent period

* Population for 1870, 1880, and 1890 from census; other years calculated by the actuary of the Treasury Department.

under a seventy and ninety cent rate. Such a result is undoubtedly referable in the main to the economic law that a reduction in the price of a commodity encourages its consumption (in this instance for industrial as well as stimulant purposes), and in a degree to the fact that a fifty-cent tax, with its accompaniment of stringent penalties, greatly diminished the incentive for illicit production. A wonderfully striking illustration of the strength of temptation for the evasion of the revenue created by the previous high taxation, which had little other reason than mere sentiment for its imposition, is also afforded by the fact that while the Government in 1872, under a tax of fifty cents per proof gallon, took cognizance of an average annual tax-paid consumption on the part of the people of the United States of 1·63 gallons per capita, it was only able to recognize in 1868, under a two-dollar tax, a similar average annual consumption of about 0·38 proof gallon *per capita*.

The second point of interest in connection with the foregoing tabular exhibit is the demonstration it affords of the very curious variations which occurred in the successive years from 1870 to 1894, inclusive, in the quantity of spirits that annually paid taxes to the Government, and which may be regarded as constituting an approximately accurate measure of the average annual *per capita* consumption of this commodity by the entire population of the country. The explanation of such changes is not difficult. They are in general unquestionably referable to immediately antecedent or contemporary changes in the business condition of the country, which in turn are determinative in a high degree of the popular ability to consume an article—like distilled spirits—of comparatively high cost and largely a luxury, popular tastes and habits and restrictive moral influences remaining constant. Thus, passing by the year 1870, in which there was a great increase (from altogether abnormal causes) in the number of gallons produced and made subject to taxation, the increase in the tax-paid product and in the average *per capita* consumption during the succeeding fiscal years 1872 and 1873, when the business of the country was fairly prosperous, was regular and not inconsiderable. The commencement of the next fiscal year (1874) was signalized by one of the most memorable financial panics in American history and a general prostration of business, from which last there was no decided recovery until 1879.

During all this period the domestic production of distilled spirits of which the Government took cognizance continued to decline, and the average *per capita* of consumption touched the exceedingly low proportions of 1·07 and 1·09 gallons in the fiscal years of 1878 and 1879 respectively. With a renewal of active and profitable business throughout the country in 1880, the

annual taxed production of spirits went up from 50,704,189 gallons in 1878 to 79,616,901 gallons in 1884, and the *per capita* consumption from 1·07 gallons to 1·45 gallons in the corresponding years. During the period from 1871 to 1880 there was a decrease both in the quantity of spirits on which the Government was able to collect a tax and in the apparent *per capita* consumption of the people, and this, too, notwithstanding an increase during this same period of thirty per cent in the population of the country; 1871 showing a tax on sixty-two and one third millions (1·58 gallons *per capita*), while in 1879 the tax was collected on only fifty-three million gallons (1·09 gallons *per capita*).

The decade from 1870 to 1879 was further characterized by two periods of disturbance—which ought to be instructive in view of future legislation—occasioned by an advance in 1873 of the gallon tax from fifty to seventy cents, and again in 1875 from seventy to ninety cents. In both cases these advances in rates were followed by large annual reductions in the quantity of the spirits taxed and in an apparent *per capita* consumption, which in turn indicated extensive revivals of illicit practices which the reduction of the tax to fifty cents in 1868 had nearly extinguished, and which indications were also made certainties by abundant direct evidence.

The decade of 1880 to 1889 showed, on the other hand, an increase in the aggregate amount paying taxes from sixty-two and one eighth million gallons in 1880 (1·23 gallons *per capita*) to seventy-seven and one eighth million gallons in 1889 (1·25 gallons *per capita*), an aggregate increase approximating a concurrent increase of twenty-two per cent in the population of the country.

During the fiscal years from 1888 to 1893, inclusive, under a uniform and prospectively stable rate of tax, an apparently good and efficient administration of the law, and a fairly prosperous condition of the country, the results in this department of our national revenues were very exceptional and interesting. The continuous increase in production, in *per capita* consumption, and in revenue was remarkable, the average increase in spirits paying taxes having been nearly 4,600,000 gallons per annum, or in a ratio greater than any concurrent increase in the population of the country; in average *per capita* consumption, nearly one third of a gallon; in average increase in revenue of nearly $5,000,000 ($4,910,000) per annum, the whole culminating for the fiscal year (1893) in a product of 99,000,000 gallons, an annual revenue of $89,000,000, and a *per capita* consumption of 1·48 gallons. During the same period the *per capita* consumption of all spirits, domestic and foreign, in Great Britain was about 1·063 gallons.

The financial troubles and business depressions in Europe and other countries during the years 1892 and 1893 do not appear to

have exerted the slightest influence on the production and consumption of distilled spirits in the United States. But the advent in 1894 of a similar state of affairs in the latter country speedily manifested itself, reducing the current *per capita* consumption from 1·48 gallons in 1893 to 1·33 gallons; the direct revenue from $89,231,000 in 1893 to $79,899,000; the current *per capita* consumption from 1·48 to 1·33 gallons, and the total annual revenue to the extent of $9,461,008.

The normal consumption of distilled spirits in the United States in 1894, as indicated by withdrawals from distilleries and warehouses, was about 8,000,000 gallons a month. The extent to which the increase in the direct tax on spirits by the act of August 28, 1894, from ninety cents to one dollar and ten cents per gallon, was anticipated by speculators is strikingly illustrated by the fact that an average monthly revenue from the lesser tax of about $8,000,000 per month during the first six months of 1894 increased during the month of July and the first twenty-seven days of August to $19,064,000 and $21,470,000 respectively, and declined in the succeeding month of September to $510,696.

Any review of the comparatively recent tax experiences of the United States would be incomplete that failed to notice its taxation (concurrent with that on distilled spirits) of domestic fermented liquors (beer, etc.). The internal revenue tax on this commodity has been practically uniform since its first authorization in 1863, namely, one dollar per barrel, holding theoretically thirty-one gallons. The tax was originally assessed and collected on the returns of the brewers, and was largely evaded. After July, 1866, it was successfully enforced through the employment of stamps, one of which, "denoting the amount of the tax," is required to be affixed upon the spigot hole or tap (of which there shall be but one) in such a way that the stamp shall be destroyed upon the withdrawal of the liquor from the barrel or other receptacle. The following table exhibits in detail the experience which has characterized each fiscal year since the inception of this source of revenue in 1863 down to and including 1894:

Years.	Population.	BEER.				
		Quantity taxed.	Quantity per capita.	Revenue collected from barrel tax.	Revenue per capita.	Tax per barrel of 31 gallons.
		Gallons.	Gallons.	Dollars.	Dollars.	Dollars.
1863.....	33,365,000	62,205,375	1·86	1,558,083	.05	1.00 .60
1864.....	34,046,000	97,382,811	2·86	2,223,719	.07	.60 1.00
1865.....	34,748,000	113,372,611	3·26	3,657,181	.11	1.00
1866.....	35,469,000	158,569,340	4·47	5,115,140	.14	1.00
1867.....	36,211,000	192,429,462	5·31	5,819,345	.16	1.00
1868.....	36,973,000	190,546,553	5·15	5,685,663	.15	1.00

Years.	Population.	BEER.				
		Quantity taxed.	Quantity per capita.	Revenue collected from barrel tax.	Revenue per capita.	Tax per barrel of 31 gallons.
		Gallons.	Gallons.	Dollars.	Dollars.	Dollars.
1869.....	37,756,000	196,603,705	5·21	5,866,400	.16	1.00
1870.....	38,558,371	203,813,127	5·29	6,081,520	.16	1.00
1871.....	39,555,000	239,948,060	6·06	7,159,740	.18	1.00
1872.....	40,596,000	268,442,237	6·61	8,009,969	.20	1.00
1873.....	41,677,000	298,633,013	7·16	8,910,823	.21	1.00
1874.....	42,796,000	297,627,807	6·95	8,880,829	.21	1.00
1875.....	43,951,000	293,033,607	6·66	8,743,744	.20	1.00
1876.....	45,137,000	306,972,912	6·80	9,159,675	.23	1.00
1877.....	46,353,000	304,111,860	6·56	9,074,355	.20	1.00
1878.....	47,598,000	317,485,601	6·67	9,473,360	.20	1.00
1879.....	48,866,000	344,195,604	7·04	10,270,352	.21	1.00
1880.....	50,155,783	413,760,441	8·25	12,346,077	.25	1.00
1881.....	51,316,000	443.641,868	8 65	13,237,700	.26	1.00
1882.....	52,495,000	525,514,635	10·01	15,680.678	.30	1.00
1883.....	53,693,000	550,494,652	10·25	16,426,050	.31	1.00
1884.....	54,911,000	588,957,189	10·73	17,573,722	.32	1.00
1885.....	56,148,000	594,764,543	10·59	17,747,006	.32	1.00
1886.....	57,404,000	642,038,923	11·18	19,157,612	.33	1.00
1887.....	58,680,000	716,767,306	12·21	21,387,411	.36	1.00
1888.....	59,974,000	765,086,789	12·77	22,829,202	.38	1.00
1889.....	61,289,000	778,715,443	12·71	23,235,863	.38	1.00
1890.....	62,622,250	854,420,264	13·64	25,494,798	.41	1.00
1891.....	63,975,000	944,823.952	14·77	28,192,327	.44	1.00
1892.....	65,520,000	986,352,916	15·05	29,431,498	.45	1.00
1893.....	66,826,000	1,071,183,827	16·03	31,962,743	.48	1.00
1894.....	68,000,000	933,373,944	14·90	30,843,764	.44	1.00

The points of interest made apparent in the foregoing tabular exhibit, and to which attention is especially asked, are as follows:

(1) The regular and great increase in the quantity of fermented liquors annually made subject to internal revenue taxation—i. e., from 62,205,375 gallons in 1863 to 1,071,183,827 gallons in 1893, and an increase in *per capita* consumption very far in excess of the rate of increase in population—i. e., from 1·86 gallons in 1863 to over sixteen gallons in 1893.

(2) The concurrent regular increase in revenue from this source—i. e., from $1,558,000 in 1863 to nearly $32,000,000 in 1893.

(3) The variations in the product of fermented liquors which the Government has been able annually to subject to taxation since 1863 have been inconsiderable and in remarkable contrast to those occurring in the case of distilled spirits. Business depression from 1874 to 1879 and for the year 1884 appears to have been influential in checking *per capita* consumption, though in a small degree, and to have exerted little or no influence in the subsequent years, that are subject to analysis, down to 1894, when financial and industrial depression was again operative in the country, results indicating that similar larger and contemporaneous decrements in consumption and revenue in the case of distilled spirits

were due to fraudulent practices, rather than to an impairment of ability to consume on the part of the masses.

(4) The average annual increase in the receipt of internal revenue from fermented liquors for the ten years from 1883 to 1892 was $1,306,057, and for the four years ending with the fiscal year 1893 about $1,617,000. That this latter ratio of annual increase under the present rate of tax is likely to indefinitely continue is almost demonstrated by the fact that the popularity of fermented or malt liquors as beverage among the American people is unquestionably increasing; and also that large, seemingly, as is their present average *per capita* consumption—namely, sixteen gallons—the present *per capita* consumption of the people of several other nationalities is much greater; that of the United Kingdom being estimated at thirty gallons; of England and Wales, thirty-six; of Belgium, forty; and of Germany, forty-five. An important fact pertinent to the prospective consumption of beer and its permanent value as a source of national revenue is, that the cost of the materials used in its manufacture has decreased in comparatively recent years, in the United States, Great Britain, and probably other countries characterized by its large consumption, to the extent of at least forty per cent; and the advantage from this change which has accrued to British brewers was stated by the British Chancellor of Exchequer, in May, 1895, to have been upward of £2,000,000 ($10,000,000) per annum. Another point of interest in this connection which is especially worthy of attention is, that if moral influences have ever materially affected the general consumption of distilled spirits or fermented liquors in the United States, the tabulated tax experiences of its Government, which constitute the only reliable basis for forming an opinion, do not afford any indication of it.

Having reformed and radically reduced the war taxes in the Department of Internal Revenue, it was next in order for Congress to consider the readjustment of the customs system of taxation, which had also been evolved, as it were, out of the war's fiscal exigencies; and it accordingly in 1867 instructed the Secretary of the Treasury to present at its next session the draft of a tariff embodying reductions of war rates. The responsibility of preparing such a draft having been next intrusted by the Secretary to the Special Commissioner of the Revenue, the latter, with a view of qualifying himself for the trust, visited Europe under a Government commission, and investigated under almost unprecedented advantages nearly every form of industry then competitive with the United States in Great Britain and on the Continent. The results of this visit and investigation effected an enlightenment on his part in respect to two salient and fundamental points:

First, that no country, with the exception of the United States, which had adopted in a greater or less degree the policy of protection through duties or restrictions on imports, had ever regarded the taxation of the imports of "raw,"* or crude, or partly manufactured materials, to be subsequently used for larger manufacturing, as an element of protection in its largest sense to its domestic industry, but rather as antagonistic to, and destructive of, such industry; and that, while such taxation in the United States had undoubtedly built up some industries and enriched their owners, it had been a great restraint on the development of a much larger and higher class of industries, employing a greater number of workmen, and paying much higher average wages. *Second*, that the countries of Europe in which the average rates of wages were lowest were the most clamorous for protective duties on imports; and that high wages in any country, conjoined with the extensive and skillful use of machinery, instead of being evidence of industrial weakness, were evidence of great industrial strength; inasmuch as no employer can continuously pay high wages unless his product is large, his labor most effective, and his cost of product, measured on the terms of labor, comparatively low.

The announcement of these views, and especially their publication in a report in 1869, created much antagonism among the advocates of the policy of extreme protection in the country; and Horace Greeley and others publicly charged that the commissioner had been induced to change his views through the corrupting agency of British gold. Notwithstanding this, a draft for a complete revision of the tariff of the United States, prepared under his almost sole supervision, and accompanied with a report on the existing revenue resources and industrial and financial condition of the country, was submitted to the Forty-first Congress by Secretary McCulloch, with his indorsement, in December, 1887. This draft, subsequently embodied in the form of a bill, with slight modifications by the Finance Committee of the Senate, came very near enactment into law, the Senate passing it by a vote of twenty-seven to ten. In the House of Representatives it failed in the closing hours of the second session by a very few votes, and not by a direct vote, but on a motion to sus-

* The definition, or rather determination, of what constituted a "crude" or "raw" material for manufacturing purposes has always been a matter of embarrassment to legislators and economic writers, inasmuch as a confessedly manufactured and often elaborate product may be relatively a raw or crude material for successively higher grades or processes of manufacture. A proposition recently proposed by Mr. Lindley Vinton, of New York, to restrict the application of the above terms in law, commerce, and economics, to the state or condition in which any product *first* enters into trade or commerce, would seem to be so free from any ambiguity of meaning as to be worthy of consideration.

pend the rules, take the bill from the Committee of the Whole, and put it upon its passage. This motion, which required a two-thirds vote, was defeated—one hundred and six in the affirmative to sixty-four in the negative. It was thus made evident that, could the bill as it came from the Senate have been brought directly before the House, it would have passed by a large majority, and probably have quieted for years all difficult and disturbing legislation on this subject.

When the office of Special Commissioner expired by limitation in 1870, the appointment as chairman of a State commission, specially created for investigating the subject and laws relating to local taxation, was tendered to its late incumbent by the Governor (Hon. John T. Hoffman) of the State of New York, and accepted. This new position afforded an almost unprecedented opportunity and facilities for becoming acquainted with a practically new department of taxation; the taxes levied by the Federal Government being mainly of an indirect character, and subject to constitutional limitations; while those of the States are mainly direct, and practically subject to no limitations as to object, except as respects imports, exports, and the property and instrumentalities of the United States. The results of this new field of exploration were laid before the Legislature of the State of New York in the form of two reports (in 1871 and 1872), with an accompanying draft of a code of laws. The facts developed on this line of investigation, and which will be restated with much additional evidence in the following chapters, are generally regarded as antagonistic to the theory of taxation as accepted and taught by most economists, and incorporated into statutes by lawmakers. The Legislature to which these reports were submitted paid no further attention to them than to order their printing. They were, however, contrary to almost all precedent, reprinted in the United States and in Europe.

NOTE.—The writer would take this occasion to acknowledge his great indebtedness to the late Isaac Sherman, of New York, whose innate modesty and desire to avoid publicity alone prevented a general recognition by his countrymen of his great intellectual ability; and that this characterization is not unwarranted is proved by the fact that it was fully admitted by such men of his time as Samuel J. Tilden, Charles O'Conor, and Rev. Dr. Bellows; and also by the circumstance that he was the one man of all others that President Lincoln selected as his adviser in the most critical periods of the war, and to whom he repeatedly tendered the highest civil offices in his gift. Mr. Sherman took a deep interest in the work of the New York State Tax Commission; participated in its investigations; contributed to its councils a very thorough knowledge of the views of English, French, and German writers on taxation, and of the cognate opinions and decisions of American and European courts and jurists; and is entitled to equal credit for whatever of merit may pertain to its conclu-

sions. If these conclusions, arrived at and expressed in the following chapters, do not meet the full concurrence of economists, the writer has the satisfaction of knowing that they received, in the main, the full indorsement of one so pre-eminently qualified to pass judgment upon them.

A STUDENT'S RECOLLECTIONS OF HUXLEY.

By Prof. ANGELO HEILPRIN.

IT was my pleasant fortune, a few years back, to have my name enrolled with a limited few in the registry book of the Royal School of Mines in London, destined for work at one of the ten or twelve tables which covered the greater part of the ground space of Prof. Huxley's laboratory. The building was a comparatively new one, having been erected as an adjunct to the new South Kensington Museum on Exhibition Road, and from the top floor looked out the various rooms in which we were to receive our tutorage from the great naturalist. A climbing flight of stone steps, with landings, wound round to this summit, to which at times of irregular journey also conducted a box "lift." On one of my daily upward saunterings I chanced to stumble upon my master, who, always a rapid walker, overtook me on the grand "round," and cordially greeted me as a fellow-traveler. Possibly I allowed myself a little to be overtaken, for, though I had already been in the workshop and lecture theater a number of days, and had answered questions on *Torula*, *Paramœcium*, and other low grades of organisms, and had even swallowed a good-natured rebuke for attempting to use a compound binocular in place of the simple, and confessedly clumsy, microscopes which were furnished gratuitously to the students, the opportunity to meet the man as man and not as teacher had not yet presented itself. Prof. Huxley's private rooms almost adjoined the laboratory, and frequently on passing the door the temptation grew strong upon me to knock and allow myself the honor of an interview, but each time a certain Tootsian timidity overcame me, and directed my course either to the right or to the left. The meeting on the landing was thus a deliverance, and Huxley allowed me to make the most of it by himself opening the conversation. It began with a reference to the deficiencies in modern building construction, particularly applied to the South Kensington annex, and evoked by the absence of proper mounting appliances. "Our lifts are not like the grand elevators in your country," remarked the professor—a thought in which it was not difficult to concur.

This first bit of extra-class conversation impressed itself forcibly upon my mind, both for the pleasure that it gave me and the

surprise it occasioned in the knowledge that I was from American soil. No reference to foreign studentship had heretofore been made, and I was a little puzzled to know what kind of information had led to the betrayal of my personality. Considerably later I learned that a close friend of my father's, the late Prof. Youmans—himself a friend equally to science and to the scientific student—had addressed a personal note to Prof. Huxley, advising him of my presence and commending me in the usual way to a kind consideration and to an equally considerate esteem. It was characteristic of the justness and fairness of the master that this letter, while it may have paved the way to a more informal acquaintance outside of the class room, in no way influenced favoritism within, or saved me from sound criticism of my work when it merited it. This was not exactly at long intervals, and particularly do I recall the painful awaiting of judgment on a mangled dissection of the nerves of the frog. "Your blue papers are where the red should be, and the sympathetic is gone"—a piece of information, the basis of a portion of which had already only too keenly been realized.

At no time was criticism given in a way to hurt, and more commonly encouragement and commendation took the place of criticism. But a thing had to be really well done to call out praise, and an exuberance of it rarely broke an echo from the laboratory walls. On one occasion I was startled by the inquiry if my drawing—a drawing of the division lines in the cells of a certain water plant—was made from the object or from imagination, an inquiry which threw doubt in my mind as to whether I was receiving praise or condemnation. The representation was considered unusually true to Nature, but I was forced to admit that it was a combined product of the visual and mental eye, and not a mere transcript of Nature. This explanation was in no way a satisfaction to Prof. Huxley, who took the opportunity to admonish the class that drawings, however true they may appear to Nature, are only true when they strictly copy the objects which they are intended to portray.

Huxley himself was an excellent draughtsman, and it was frequently remarked of him, as it was also of our own Dr. Leidy, that had he devoted himself to painting, instead of to science, he would have forced himself to a position not less prominent as an artist than that which he occupied as a naturalist. He was always precise in his drawings on the blackboard, and if he could not, perhaps, like Prof. Weisbach, of Freiberg, jump to a circle and punch its middle point with a stub of chalk, he could, apparently without any hesitancy, draw the most complex anatomical constructions, and in such a way as to make every point clearly intelligible to the student. It was probably from the father's

side that Mrs. Thomas Collier, *née* Huxley, who had well earned her several premiums from the fine-art institutions of London, inherited her tendencies and capabilities in the direction of painting. Inspired in a measure, probably, through his love for art, and with an inborn feeling for mechanical constructions, Prof. Huxley always held a kindly sympathy for all that pertained to the science of engineering; and he frequently expressed the thought, which will doubtless seem strange to many, that he had missed his vocation, and that the true field of his activities should have been the field of an engineer. Yet it is singular that with this proclivity for a branch of study which requires for its successful accomplishment a generous supply of mathematical stimulus, the fact that he was in no way a mathematician did not terrify Huxley. He frequently admitted that he had neither a liking nor an aptitude for figures, and it was a timely forethought in lecturing, when a condition required a mathematical calculation for its elucidation, to have the answer written in advance at one corner of the board. This, as was naïvely explained by the lecturer, was to avoid the easy possibility of an error creeping into an offhand calculation or problem in sums.

In lecturing to his classes Huxley adhered strictly to business, and it was rarely that a matter of levity was introduced to give merriment to his listeners. I recall, in a course of some seventy lectures, only a single instance of this kind, when, for some reason (no longer in my memory), a reference was made to Chamisso's Peter Schlemiel—a book which Prof. Huxley frankly admitted gave him more genuine pleasure than any other in nonscientific literature. Whether it was the refreshing frankness of this admission, or the fact in itself that was quoted, which on this occasion brought forth an unbounded merriment from his students, was perhaps not fully decided for all of us, but there was no questioning the spontaneousness of the applause which followed the utterance. And this, as I now recall it, was the only instance of applause greeting the lecturer in the middle of the lecture during the entire course of my studentship. Huxley, like Tyndall, was always careful to have his lectures fully prepared. A few notes jotted down on a fly-sheet of paper or in small notebooks were the only guide for the full hour, which to most of the students passed very rapidly. There was no display of eloquence, no attempt to clothe description or explanation in floral verse, but everything was stated in terse and succinct language, although with due emphasis on important points, and this it was that made it easy to follow. These class lectures were naturally very different from public addresses, in which Huxley always maintained that wonderful dignity of expression and choice rhetoric which have been the despair of his combatants, scientific no less than

clerical, and have for all time rendered classical that which he has chosen to put in print.

Contrary to what is generally supposed, Huxley was not a ready speaker, or perhaps it would be more true to say that his deliverances were not unaccompanied by stage fright, or a nervous uneasiness which frequently required for its subjugation a strong mental effort. It was this that told heavily on his health, and more than once the quiet resolve had been made to forever abandon the public platform. I was present on one occasion at a rather extensive gathering where, following a few after-dinner remarks by Sir Joseph Hooker, Prof. Tyndall, and Sir Wyville Thomson, Huxley, contrary to previous agreement, was also called upon for a few words, and with the pleasing introduction (as nearly as I can now recall the passage), "There is one among us who, by reason of his witty tongue and ever-readiness, it is a pleasure to call upon."

Following the applause which greeted his name—the mention of which was unmistakably a disagreeable surprise to the one more particularly concerned, Huxley took occasion to explain in emphatic language that were it only generally known how much of an effort it cost him to speak, his friends would willingly allow him more peace, and save the lingering wreck of his bodily frame. This admission—which was followed by a short but most happy *ex-tempore* utterance—appeared to me so strange that I was determined on the first proper occasion to obtain at first hand its true meaning. The opportunity presented itself a few days later, immediately after the conclusion of a stirring public address (read from manuscript) on "Sunday Opening," if by this name we may designate the liberty of displaying and using on the Sabbath-day collections of books and paintings, museum and other treasures, and of listening to scientific discourses. Dean Stanley and one or two other speakers had preceded him, but manifestly the audience was waiting for the speaker of the occasion. A more brilliant and incisive arraignment of those who by legal process attempted to forever remove from the workingman his one day of self-improvement could hardly have been formulated, and the speaker was greeted with vociferous applause. Meeting him on the way homeward from the lecture hall, I asked for a significance of the explanation made a few evenings before at the dinner table, for it did not seem possible to me that one gifted with such fluent powers of speech, and backed by an almost unfathomable fund of knowledge, could feel any fear or hesitancy in speaking, no matter what the occasion. In his answer, Prof. Huxley repeated in substance what he had before said, only more clearly emphasizing the nervous fear with which he mounted the platform. He then assured me that he might have saved himself an African journey, under-

taken for health recuperation, had he abstained from public deliverances.

It has been frequently assumed that Huxley cared for little beyond science, and especially for that side of it which was combative either with the Church or with the State, but nothing could be further from the truth than the belief that this was in fact the case. It is perfectly true that Huxley used all the vigor of speech of which he was capable to emphasize what he considered to be the proper position of science in any education, and perhaps he even considered the acquisition of scientific knowledge to be of more importance than any other form of learning, but he was always careful to emphasize that education was only such when it was broad and comprehensive, when it comprised not only science, but in addition a goodly share of the world's history and literature. His own resource in the fields of literature (English, French, German, and Italian) and history was prodigious, and he rarely was at a loss to instantly take advantage of a citation from some early scholar to demolish at first or second hand an adversary at arms. When I was in London he was reading, with the assistance of a friend, Russian, and mainly for the purpose of fully familiarizing himself with the work of the great anatomist, A. Kovalewski, whose writings he was seemingly the first to bring to the critical notice of English-speaking naturalists. It was this thorough familiarity with what one is almost tempted to call universal knowledge that made Prof. Huxley such a dreaded foe to his enemies, and it has well been remarked, "Woe be to him who attempts to measure arms with such an antagonist!"

Huxley was a firm believer in thorough knowledge, and he took no stock in brain-stuffing; to have known a thing once, and to be able to put your hand upon it when you again want it, was his maxim. The opening address delivered by him before the Johns Hopkins University, in 1876, gives the keynote to his position in the matter of special training. "Know a thing directly," he often remarked, "and do not assume that you know more of it by knowing *around* it." He had no patience with those who spoke with a pseudo-authority begotten of chance, and was bitter in his denunciation of officialism as affording a pretext for either defending or attacking scientific dogma. An interesting anecdote, which Prof. Huxley himself related to me, shows the occasional happy frame of mind in which our *savant* found himself when he, in turn, was receiving blows. A prominent bishop of the English Church, whose name it is not here necessary to mention, had been for some time endeavoring to smash the Darwinian hypothesis through some actual researches in zoölogy which he claimed to have undertaken. Toward the accomplishment of this laudable effort he used many pages of the current magazines and equally many

columns of the daily press, in each of which the "undernurse of Darwinism" came in for an uncommonly large share of ridicule. Finding that none of these papers brought forth any comment from Prof. Huxley, their author in a personal letter called his attention to them, at the same time asking to be advised as to what particular course of reading would most readily enable him to grapple with the various scientific questions which at that time agitated the world. Prof. Huxley's full and laconic answer was, "Take a cockroach and dissect it." No further inquiry came from that source.

I once found Prof. Huxley much depressed over a small paragraph which also touched, and in a very depreciatory manner, the evolutionary hypothesis, which had been contributed to the daily press by his friend Carlyle. He greatly deplored the recklessness of the utterances contained in the squib, and especially painful to him was a markedly undignified reference to the one man for whom Huxley had a greater reverence than for any other—Charles Darwin. To my interrogatory as to whether he considered it necessary to reply to the paragraph, he promptly and emphatically answered, "No!"

Remorseless as Huxley occasionally was in the cold exposition of the blunders of his colaborers in science, he was usually very lenient to those who pointed out his own mistakes. I remember one occasion when a post-graduate student of the Royal School of Mines, Patrick (now Professor) Geddes, intimated to the professor that his interpretation of the mechanism of the radula in the common garden snail, as was set forth in the Anatomy of Invertebrated Animals, was not supported by the newer laboratory dissections. Prof. Huxley's response was a request of Mr. Geddes to try a new dissection; it was done, and it was found that the pupil was right and the master wrong. Only once do I recall when a correction was received with a regret almost akin to displeasure—the case of the *Bathybius*, the all-pervading protoplasm of the oceanic deep. When Sir Wyville Thomson separated this substance as a mineral precipitate, it smashed a thought that had already become pregnant with English and German naturalists, and which threatened to become of genuine usefulness in explaining the origin and development of the organic life forms of the earth.

Among his many eminent scientific contemporaries there were few for whom Huxley had greater admiration than the German morphologist, Gegenbaur, and Karl Vogt; the latter he regarded as a tower of strength and in a certain sense a genius. When, nearly two years after leaving London, I returned to my alma mater and informed my past master that I had in the meantime been enrolled as a student, although in the class of paleon-

tology instead of zoölogy, under Vogt, he appeared to be really pleased, and expressed himself freely on the advantage of being guided by so eminent an authority and so liberal a thinker as was the self-imposed exile of the University of Geneva. And in truth it must be admitted that there was much in Vogt that reminded me of Huxley. Like the latter, he was fearlessly outspoken in his utterances. Witness his tirade against the late Emperor William of Germany, delivered as a protest against the expenditure of the state's money on bronze and iron cannon when it could have been more humanely and profitably used in the purchase of the then recently discovered second specimen of *Aarchæopteryx*—that strange fossil hybrid connecting bird and reptile which has since found its way to the Berlin Museum. Like his English prototype, Vogt was also an admirable lecturer, fluent in diction and facile with the crayon, but it can hardly be claimed that either the quality or the tone of his lectures was fully representative of the scholarship of their author.

Vogt never allowed the opportunity of a pun to escape him, and his *bons mots* were at times hardly more elegant than they were appropriate; but, for all that, he was very popular, and equally so with the few women students of his class as with the men. He spoke in French with a decided German intonation, frequently relieving himself of a sigh brought about by an uncomfortably asthmatic condition. His powerful bodily frame, disproportionably shortened through a generous development of tissue about the equatorial region, was in marked contrast to the tall and nearly upright carriage of Prof. Huxley, whose slightly stooping head and shoulders reduced somewhat what might otherwise have been considered a more than average height. Huxley never entered the class lecture room except in a dress in which he was immediately prepared to go to the street; Vogt rarely appeared without a coat which did not in one or more places show visible signs of underlying shirt sleeves. The presence of women in no way affected his *Wohlgefühl*, and in truth it must be said that this class of students was to him in a measure a blank, as he invariably addressed the class only as "*Messieurs.*"

Among the many warm friends and admirers that Huxley numbered within the ranks of the scientific fraternity there was none who was more enthusiastic in his admiration of the great man than the distinguished comparative anatomist of the Royal College of Surgeons, the late Prof. Kitchen Parker. An afternoon and evening spent at the home of this most genial and all-overflowing host serves my memory as the record of one of the pleasantest incidents of my student life in London. Huxley and Parker had not many years before announced their new classification of birds—worked out conjointly on characters founded

principally on the position and construction of the bones of the palate and beak—and the stir which that radical departure in classification brought out had not yet subsided. Prof. Parker was still largely engaged in proving his case, and was naturally, to use an expression that is less elegant than determining, full of it. The overjoyful manner in which he pointed out a confirmatory character here and there, or an exception to the rule elsewhere, kindled a glowing enthusiasm within the listener to follow in the line of the master, and a desire to make immediate friends with basi-sphenoid and pterygoid bones. Drawer after drawer of neatly prepared bird skulls, colored in correspondence so that identical or homologous parts could be immediately detected, were pulled out and hastily scanned over; but the explanations that were given, whatever they might have been, were liberally sprinkled with admiration for the genius of Huxley—who first broke into the method which Parker so successfully elaborated—a second to whom was not to be found in all Britain. I shall not easily forget the ocular gleam of pleasure, perhaps even delight, with which Prof. Parker announced dissent on certain anatomical points from the opinions of his friend and colaborer. The following very graceful tribute to the clearness of Prof. Huxley's expositions appears in this author's article on Birds, contributed to the ninth edition of the Encyclopædia Britannica (page 717): "The writer will often use the very words of Prof. Huxley, despairing as he does of coming near that excellent writer either in condensation or order."

Huxley, as is well known, was a master hand in the construction of the English language. For elegance and force of diction he had no superior—perhaps not even an equal—among the writers of his day, and there are few purely literary men whose productions maintain so uniformly a high quality of excellence. In borrowing from the decorative side of language, he never allowed the embellishment of phrases to interfere with the clear statement of what he had to convey either by word of mouth or of pen, or to in any way cloud his meaning. Friends and foes thus knew his position precisely, and he was always taken on his own recognizance. A strict adherence to the sequence of truth, fact, and a logical deduction from facts, was his maxim, and it was this that assured his ground for battle, and carried him triumphantly through nearly all his combats. As has before been remarked, Huxley took little stock in brain-stuffing, yet it can in no way be complained of that his own brain was "of the empty kind." The range of topics that his conversation touched was almost bewildering, yet so discreetly was his knowledge dispensed that oftentimes one assumed that he was making an inquiry, when, in fact, he was giving the answer to it. Well do I recall a meeting on Brompton

Road when the conversation almost immediately turned upon American racing and race horses, a topic on which I was obliged to confess myself an absolute ignoramus by the side of my interlocutor.

A few parting words. In 1893 I had the pleasure of being constituted one of a committee of five on the award of the Hayden Memorial Medal of the Academy of Natural Sciences of Philadelphia—a medal (and accompanying fund) awarded for meritorious work in the domain of geology and paleontology. The award was made unanimously, and almost without discussion, to Prof. Huxley, and his name thus appears in association with the names of James Hall, Cope, Suess (of Vienna), and Daubrée (of Paris), other recipients and masters in a field with which the labors of Prof. Huxley are not very generally associated. The following characteristic reply, acknowledging the receipt of the award, was addressed to the Academy.

HODESLEA, STAVELY ROAD, EASTBOURNE, *January 4, 1894.*

GENTLEMEN: The Hayden Memorial Medal, with your draft (which will incorporate itself into an ornament for my wife's drawing room), reached me the first of the month, a New-Year's gift of a value quite unexampled in my experience. I am very sensible of the great honor which the Academy of Natural Sciences of Philadelphia has conferred upon me—a retired veteran who has much reason to suspect that he has already received quite as much promotion as he has deserved.

But increasing years, if they bring a diminution of variety (I am not sure they do), leave the desire for the esteem of those who have a right to judge us intact, perhaps intensify it; and I beg leave to assure you and your colleagues—fellow-workers of Hayden and of Leidy—that the kindly and sympathetic terms of your award have given me very great pleasure.

With all respect, I have the honor to be, gentlemen,

Your obedient servant and colleague,

THOMAS HENRY HUXLEY.

It is not for the student to sum up either the quality or the quantity of the labors of his teacher and master, but for those who still doubt—and there are some such—the justice of the position which has by almost common consent been given to Huxley in the realm of science, it may be recommended as a healthy exercise to carefully read the titles of the hundreds of papers with which this indefatigable writer, for the better part of half a century, has crowded the pages of scientific journals and popular magazines; and after that, with equal care, the inquirer into fame will take an advantageous turn in mastering the papers to which these titles

relate. Huxley was great not because he correctly deciphered the history of a fossil bone, not because he probed deep into the anatomical or physiological mysteries of the living world, nor yet for the reason that he was well-nigh the first—one might say, indeed, the first—to pound the truths and consequences of evolution into the material world, but because in addition to these accomplishments, and much more, he molded the tendencies of modern thought, and to a greater extent than any scientist of his generation with the exception of Charles Darwin. Well could this great philosopher observe that, had it not been for Huxley, the acceptance of the evolutionary hypothesis would have been removed from us by probably at least a generation.

THE BOTANICAL GARDEN OF BUITENZORG, JAVA.

By M. ALBERT TISSANDIER.

THE importance of establishing botanical gardens—the utility of which is incontestable—in suitable spots, and particularly in its colonies, has been perceived by nearly every nation. The English, as early as 1786, planted a very fine garden at Calcutta, under the direction of Colonel Robert Hyde; and in 1821 they created the Garden of Peradeniya, near Kandy, in Ceylon. The French Government has laid out interesting botanical gardens at Saigon, in Cochin China, and on the island of Réunion.

The Dutch established in 1817 the Garden of Buitenzorg, on the island of Java, and have made it the finest in the world. It is situated on one of the long ridges that descend on the north from the Salak Mountain to two hundred and eighty metres above the level of the sea. In 1857 the garden was arranged by M. Hasskari, botanist at the time, and at the suggestion of M. Diard, director of a French Natural History Society, into sections, in which the plants of the same family were grouped together. As a result of this scientific organization, which then existed only incompletely in other gardens, the establishment took the first rank. It possesses other considerable advantages growing out of the exceptional importance of its collections of all tropical species, and the generous hospitality with which it receives all foreign naturalists who resort to it for study. The present director, Dr. Treub, an accomplished botanist, has labored constantly for the improvement of the plantations. The garden has been much enlarged within recent years.

The Dutch Government has comprehended from the very foundation of this establishment that a single botanical garden would not be enough, and has supplemented it with annexes. The gardens supported by the state are divided into three parts: the

botanical garden of Buitenzorg, the most celebrated, the surface of which covers one hundred and forty-eight acres and a quarter, situated in the city next to the residence of the governor; the agricultural garden of Tjikeumenh, of one hundred and seventy-

FIG. 1.—ENTRANCE TO THE MUSEUM OF HERBARIA, BOTANICAL GARDEN OF BUITENZORG, JAVA. (From a photograph.)

three acres; and the garden of forestry, with a reserve in the virgin forest, which together occupy seven hundred and forty-one acres.

The climate of Buitenzorg and its vicinity is especially favorable to the development of plants. It is at the same time very warm, the mean temperature being 82° or 83° F., while during the dry monsoon the thermometer may rise to nearly 90° F. The constant moisture, afforded by a rainfall that amounts to more than twelve feet of water a year, gives the culmination of these conditions. In Holland, where it rains a great deal, the annual mean is only about twenty-six inches.

A number of the trees in the garden have grown extraordinarily. Some palm trees of the genus *Oreodaxa*, planted when very young along the borders of an alley, grew in five years to a height of more than thirty-two feet; while plants of *Albizzia Moluccanna* grew in the same time to about sixty-five feet. The section of palms, the ferns, climbing plants, and gigantic lianas surpasses in interest all that can be found in any other botanical gardens.

As a result of the perfect scientific arrangement of the garden, the stranger, with a plan in his hand, which is furnished gratuitously to all who wish to work there, can find his way at once to whatever section he is most interested in. Numbers, referred to the catalogue, are marked on each species of the several families. When foreign students arrive, they are received immediately by

the director, and assigned a place in the grand laboratory where they can study as they will, free of charge. A small library of the books most in demand and all the materials needed for experiments are kept conveniently at hand in the great room. A photographic laboratory is very near; next is the great laboratory containing the old botanical books and a complete collection of modern periodical publications of all countries. These journals represent all subjects related to botany, agricultural chemistry, and pharmacy. This library is situated in the pavilion containing the collection of herbaria, and behind this is the laboratory where poisonous plants are studied. In buildings by the side of these are collections representing all the forest plants of the country.

The agricultural garden of Tjikeumenh is twenty minutes' carriage ride away. The road is a charming one, bordered by villas with luxuriant flower gardens and fine trees. Strangers can also work in this garden, as at Buitenzorg, and are given separate laboratories, arranged somewhat like those in the museum at Paris. To the garden of forestry is a ride of five hours. The

FIG. 2.—LABORATORY OF THE BOTANICAL GARDEN AT BUITENZORG. (From a photograph.)

excursion is one for which supplies have to be taken, but the country is a very fine and picturesque one, and the time passes without our thinking that we have been long on the road. The pavilion of Tjibodas, where visitors are received, is situated at an altitude of about fifteen hundred metres, and contains every desirable comfort. Foreign students have the privilege of a saloon

furnished with a library and a large room for work. A dining room and a few bedrooms are provided, for there is no hotel. The garden of forestry, situated about halfway up the old volcano of Gedé, is planted chiefly with Australian and Japanese trees and shrubs. Of these, perhaps the most remarkable are the curious specimens of the Australian *Xantoroa actinis* in front of the mountain pavilion. The forest of Tjibodas, in which the garden is placed, is a remarkable one. Paths have been traced which lead by numerous windings to interesting spots, up to the height of about two thousand metres. Outside of these paths one could not go three steps on account of the impenetrable thickness of the woods. The ground is carpeted with a world of mosses and finely

FIG. 3.—RECEPTION PAVILION FOR FOREIGN STUDENTS IN THE FOREST GARDEN OF TJIBODAS. JAVA. (From a photograph.)

cut ferns, of the most surprising and various forms. In the trees of from one hundred to one hundred and twenty feet high are masses of orchids, ferns, and lianas to make one dream, away up to the topmost branches. The lianas in some places form complete stalagmites of verdure, so thickly covered are their supple stems with mosses and broad-leaved parasites. They form an inextricable but transparent network, through which the rays of the sun pass to lighten up the minutest details of these rare beauty spots.

The vegetation varies constantly as we ascend the slope of the Gedé, and seems to grow more and more interesting.—*Translated for the Popular Science Monthly from La Nature.*

HELIUM, ITS IDENTIFICATION AND PROPERTIES.

By Prof. C. A. YOUNG.

THE famous "D_3," so called because it is very near the D lines of sodium, is a bright yellow line in the spectrum of the solar chromosphere, in which it is more conspicuous than anything except the C and F lines of hydrogen. Unlike them, however, it has no corresponding dark line in the ordinary solar spectrum, a rather perplexing fact which has caused much discussion, and has not even yet found an explanation in which all authorities agree.

It was discovered in 1868, when the spectroscope was for the first time directed upon a solar eclipse. Most of the observers supposed it to be the sodium line, but Janssen noted its non-coincidence; and very soon, when Lockyer and Frankland took up the study of the chromosphere spectrum, they found that the line could not be ascribed to hydrogen or to any other known terrestrial element. As a matter of convenient reference Frankland proposed for the unknown substance the provisional name of "helium" (from the Greek "helios," the sun), and this ultimately, though rather slowly, gained universal acceptance.

Within a year, two other lines (λ 7,065 and λ 4,472) were discovered in the chromosphere spectrum by Rayet and Respighi respectively, which like D_3 are always present in the prominences, but have no corresponding dark lines. It was of course early suggested, but without proof, that these lines might also be due to helium. Since then some eight or ten other lines have been found, frequently, but not always, presenting themselves in the chromosphere spectrum, and, like the first three, also without dark analogues. Moreover, still more recently, D_3 and its congeners have been detected in the stellar spectra—*dark* in the spectra of the "Orion stars," *bright* in the spectra of certain variables and of the so-called Wolf-Rayet stars; and *both bright and dark* in β Lyræ and the "new star" of Auriga which appeared in 1892.

Naturally there has been much earnest searching after the hypothetical element, but until very recently wholly without success; though it should be mentioned that in 1881, Palmieri, the director of the earthquake observatory upon Vesuvius, announced that he had found D_3 in the spectrum of one of the lava minerals with which he was dealing. But he did not follow up the announcement with any evidence, nor has it ever received any confirmation, and from what we now know as to the conditions necessary to bring out the helium spectrum, there is every reason to suppose that he was mistaken.

The matter remained a mystery until April, 1895, when Dr. Ramsay, who was Lord Rayleigh's chemical collaborator in the discovery of argon, in examining the gas liberated by heating a specimen of Norwegian clèveite, found in its spectrum the D_3 line, conspicuous and indubitable. The mineral was obtained from Dr. Hillebrand, one of our American chemists, who had previously studied it, and ascertained that it could be made to give off a gas which he identified with *nitrogen*. It really was nitrogen in part, but Ramsay suspected that he should also find *argon*, as he did—and helium besides, which was unexpected.

Clèveite is a species of uraninite or pitchblende, and it soon appeared that helium could be obtained from nearly all the uranium minerals, and from many others; from many, mingled with argon; from others, nearly pure. In fact, it turns out to be very widely distributed, though only in extremely small quantities, and generally "occluded," or else in combination—seldom, if ever, free. It has been detected in meteoric iron, in the waters of certain mineral springs in the Black Forest and Pyrenees, and Kayser even reports traces of it in the atmosphere at Bonn.

It is generally obtained by heating the substance that contains it in a close vessel connected with an air pump of some kind by which the liberated gases are drawn off and collected. They are then laboriously treated to remove as far as possible all the foreign elements (nitrogen, etc.), since the presence of no more than five or ten per cent of other gases prevents the new elements from giving any spectroscopic evidence of their presence; they are too shy and modest to obtrude themselves. In many cases, as has been said, argon and helium come off together, and certain lines in their spectrum are nearly coincident, so that for a time there was supposed to be some close bond of connection between them. The latest observations, however, make it certain that this is not so: as Mr. Lockyer puts it, "argon is of the earth, earthy, but helium is distinctly celestial."

Its spectrum has been thoroughly studied by Crookes, Lockyer, and Runge, who agree as to all its leading characteristics.

Runge, whose work is the most complete and authoritative, finds that its lines have a remarkably regular arrangement, falling into two distinct "sets," each set consisting of a principal series and two subordinate ones, the lines in each series corresponding very accurately to a formula quite similar to that discovered by Balmer as governing the hydrogen spectrum.

In the whole spectrum he finds (by photography mainly, though two of the most important were detected by the bolometer) sixty-seven lines, twenty of which only are in the visible part of the spectrum. Of the sixty-seven, twenty-nine belong to

the first "set" and thirty-eight to the second. Of the twenty "visual" lines, thirteen have been observed in the spectrum of the chromosphere; the missing lines all belong to the second subordinate series of the first "set," and are so faint in the artificial spectrum of the gas that their failure to be found in the chromosphere needs no explanation.

The fact that the lines thus divide into two mathematically independent "sets" has led Runge to believe that the helium obtained from the minerals is really a mixture of two distinct gases, and he has found it possible to partially separate the two by a process of diffusion. The true helium, the element that gives D_3 and the other lines that are *always* present in the chromosphere spectrum, he considers to be the *denser* of the two; the spectrum of the other contains most of the lines that appear only occasionally in prominences. The lighter component has as yet received no name. Lockyer calls it simply X.

The lines of the series to which D_3 belongs are all *double*, having a very faint companion on the lower (i. e., red-ward) side, extremely close to the principal line. When Runge announced this discovery early in June it at first produced something like consternation among spectroscopists, for at that time there still remained more or less doubt as to the validity of Ramsay's identification, and the solar D_3 had never been observed to have such a companion. Very soon, however, Hale, Huggins, Lockyer, Reed of Princeton, and other observers who had sufficiently powerful instruments, detected the little attendant of D_3 in the spectrum of prominences, so that the momentary distrust was replaced by absolute confidence.

As to the physical and chemical properties of the new gas, our knowledge is still limited and our conclusions are embarrassed by the uncertainty whether we are dealing with a single element or a mixture—whether Dr. Ramsay has introduced to the world one infant or a pair of twins.

The gas liberated from clèveite, and purified as far as possible, shows a density just a little more than double that of hydrogen, and is therefore much lighter than any other known gas except hydrogen itself. If it is a mixture, the lighter gas must have a density less than two, and may even prove to be lighter than hydrogen; while the true D_3 helium may have a density anywhere between two and four, depending on the proportions of the mixture and the density of the lighter compound. In any case both the true helium and X are lighter than anything else but hydrogen.

It would be very fine, we may remark in passing, if the lighter component could have been identified with "coronium," but this seems impossible since the characteristic 1,474 line (λ 5,316) does

not appear at all in the spectrum of terrestrial "helium" derived from any source whatever.

Ramsay's acoustic experiments tend to show that helium, like argon, is monatomic, but can hardly be considered conclusive. If he is right, the atomic weight of helium regarded as a single element would be not far from four; but thus far all attempts to make it enter into chemical combination have failed, though it seems rather probable that in the uraninite minerals it is held by stronger bonds than those of mere occlusion.

Olszewski has tried his best to liquefy the gas, but thus far unsuccessfully; the methods that have conquered every other gas, hydrogen itself included, have failed with helium—a circumstance very remarkable, since generally a denser gas liquefies more easily than a lighter one, and hitherto hydrogen has stood pre-eminent in its refractoriness. The fact that the gas is probably a mixture may explain his failure: air is more difficult to liquefy than either oxygen or nitrogen.

Probably the question has suggested itself to every reader how it happens that helium, so conspicuous in the atmosphere of the sun and many stars, should be so nearly absent from our own atmosphere and so scantily present in any form upon the earth. The answer seems to depend upon two facts—the chemical inertness of the substance and its low density.

According to Johnstone Stoney's deductions from the accepted theory of gases, no *free* gas of low density can remain permanently upon a heavenly body of small mass and habitable temperature, but the molecules will fly off into space. A particle leaving the earth with a velocity of about seven miles a second would never return to it, this "limiting velocity" depending upon the mass of the earth and its diameter. Now, according to the dynamic theory of gases, the molecules of our atmosphere are flying swiftly about with velocities (at ordinary temperatures) of from fifteen hundred to fifteen thousand feet per second; the heavier molecules, like those of oxygen and nitrogen, move comparatively slowly, but if any lighter gas, like free hydrogen or helium, is present, its molecules take up velocities several times more swift, and any that may happen to be near the upper limits of the atmosphere would be likely to be thrown off into space. In the case of the moon even the oxygen and the nitrogen would go, since she is so small that a velocity not much exceeding a mile a second would carry them off. If this is correct, it is easy to see why we now have no appreciable quantity of *free* hydrogen or other light gas in our atmosphere.

But while we have no atmospheric hydrogen to speak of, hydrogen *in combination* is extremely abundant; one eighth part by weight of all the water in the sea is hydrogen; and hydrogen

combines freely with many other elements besides oxygen, so that we continually liberate it in all sorts of chemical decompositions. Helium, on the other hand, enters into combination most sparingly, is therefore scarce, and even when present is, as we have said before, not easy to detect.

SCIENTIFIC TEMPERANCE.

By DAVID STARR JORDAN.

AMONG the exhibits at the Columbian Exposition of 1893 was a map illustrating the progress of "scientific temperance" in the United States. On this map those States of the Union in which scientific temperance was a compulsory study in the schools were shown in white. Those States which had not yet reached this condition were shaded in black. The Northern States generally were white in color, while dark shades covered much of the region south of the Ohio and Potomac. From this dark area, however, one long black tongue stretched itself to the northward from the Ohio River to Lake Michigan, separating the whiteness of Ohio and the Northeast from that of Illinois and the Northwest. Indiana alone in the North was a stumbling-block in the triumphal march of the cause, the only district in which "science" and "temperance" were not hand in hand.

This map leads one to consider for a moment the educational history of Indiana, and especially the conditions under which instruction in human physiology becomes changed into "scientific temperance."

With a view to lessening the cost of school books, the Legislature of Indiana in 1889 passed an act directing the State Board of Education to contract with competing publishers for a uniform series of text-books for the State. By the terms of this law the standards were made high and the prices low, the low prices to be made possible by the large sales of the books chosen. In putting this law into action, the State Board of Education, of which the present writer was a member, made a good deal of interesting history, most of which need not be discussed here.

In the subject of human physiology the series of text-books chosen as the best was one written for this competition at the instance of a local publishing house. The author of this series is a teacher of biology, familiar with methods and results of scientific research, and who has also a large interest in the teaching of children. In the judgment of the Board of Education, one of the points of superiority in this Indiana series over other works offered in competition was the scientific way in which the difficult

question of temperance was treated. In other words, the reasons for temperate living were stated as truths of science in the proper relation to other truths. But, as events have proved, this statement did not contain the essence of "scientific temperance." It is as sign of condemnation of the series adopted by us that the State of Indiana appears in black on the white charts of the "National Woman's Christian Temperance Union."

Let us, therefore, examine the teachings which are thus placed under ban. On pages 289, 290, and 291 (Advanced Lessons in Human Physiology: Indiana State Series), we read:

"ALCOHOLIC DRINKS.—The most serious and widespread derangement of the natural tastes is that caused by alcoholic drinks. Alcohol has been demonstrated to be a poison. Its continued use, even in what are called moderate quantities, will pave the way for many diseases, some of which are sure to overtake those who have the habit of using drinks with alcohol in them.

"Examples of the effects of the excessive use of alcoholic drinks are numerous and revolting enough in most communities to make the strongest of appeals against their use.

"When it is seen that by the means of alcohol an intelligent man may act without reason; that a kind-hearted man may become brutal to his most loved friends; that it may cause an honorable man to become a dishonorable one; that it may make a noble nature become one with the most depraved of tastes; when its use has over and over again been the cause of bitter disappointments, of intense suffering, and of crime, it would seem that vastly stronger reasons existed against its use than that of the mere fact that some slight changes in the tissues occur which might possibly be demonstrated. It is to avoid these most serious results that the use of alcohol is to be shunned, and not simply to avoid a differently shaped liver.

"The physiological effects of poison are generally much greater than the visible changes which they produce in the tissues would lead us to expect. Indeed, such effects can seldom be detected by the changes seen in the tissue cells.

"Strychnine produces powerful spasms, which end in death. It acts, it is said, on the spinal cord, but it would be hard to show any changes that it produces in the cells. And a knowledge of the changes it produces in the cells could not make us fear the poison any more than we do who know that it results in suffering and death.

"THE MODERATE USE OF ALCOHOLIC DRINKS.—The most serious results so well known are, of course, from the effects of excessive use. But in the moderate use of these drinks there is constant danger, as has been demonstrated a countless number of times, that the 'moderate' may grow into the immoderate use.

"Even the continued moderate use of alcoholic drinks is, as has been said, almost certain to lead to some of the many forms of disease which are ready to invade some portion of the body that has had its processes of nutrition for a long time thus disturbed. If we now add to this the constant imminent danger of the growth of an already abnormal appetite for such drinks until it leads to excess in their use, which is so revolting in its every aspect, is there not enough to deter one from even a moderate cultivation of this dangerous appetite?

"NARCOTICS.—There are a number of other poisons whose use the body at first endures, though with considerable protest, but which finally have the effect to cultivate a demand for the poison that generally ends seriously or fatally.

"Among the most dangerous of these is morphia, which appears in many forms of medicine. The morphine habit is fully as dangerous as the alcohol habit.

"The tobacco habit, while it does not compare with those just discussed in the seriousness of its results, is of no benefit, is of great and useless expense, and is often the direct cause of a derangement of the healthy actions of the body. Its use has been demonstrated to be very dangerous to the young. It is a habit easily avoided, and one that no one who has formed it would advise you to form."

As soon as this book with its associate (Primary Lessons in Human Physiology) came into use, agitation was begun against it, not because of any defect in its science, not because its stand was not strongly against the use of stimulants and narcotics, not because of any lack of fitness in its methods, but because it was not a book of "scientific temperance."

At last, after some four years of agitation, an act was passed in Indiana by which "scientific temperance" must be forced into those books, or the books themselves taken out of the schools.

I have not the text of the Indiana law at hand, but I understand that it is based on a law lately enacted under like influences in the State of New York. The full text of the New York law is as follows:

"To amend the consolidated school law providing for the study of the nature and effects of alcoholic drinks and other narcotics in connection with physiology and hygiene in the public schools.

"The people of the State of New York, represented in Senate and Assembly, do enact as follows:

"SECTION 1. Sections 19 and 20 of Article XV of the consolidated law are amended to read as follows:

"19. The nature of alcoholic drinks and other narcotics and their effects on the human system shall be taught in connection with the various divisions of physiology and hygiene as thor-

oughly as are other branches for not less than four lessons a week for ten or more weeks in each year in all grades below the second year of the high school in all schools under the State control or supported wholly or in part by public money, and also in all schools connected with reformatory institutions. All pupils must continue such study till they have passed satisfactorily the required primary, intermediate, or high school test in the same, according to their respective grades. All regents' examinations in physiology and hygiene shall include a due proportion of questions on the nature of alcoholic drinks, tobacco, and other narcotics, and their effects on the human system. The local school authorities shall provide facilities and definite time and place for this branch of the regular course of study. All pupils who can read shall study this subject from suitable text-books, but pupils unable to read shall be instructed in it orally by teachers using text-books adapted for such instruction as a guide and standard, and these text-books shall be graded to the capacities of primary, intermediate, and high school pupils. For students below high-school grade they shall give at least one fifth their space, and for students of high-school grade shall give not less than twenty pages to the nature and effects of alcoholic drinks and other narcotics, but pages on this subject in a separate chapter at the end of the book shall not be counted in meeting the minimum. No text-book on physiology not conforming to this act shall be used in the public schools except so long as may be necessary to fulfill the conditions of any contract existing on the passage of this act.

"20. In all normal schools, teachers' training classes, and teachers' institutes adequate time and attention shall be given to instruction in the best methods of teaching this branch, and no teacher shall be licensed who has not passed a satisfactory examination in the subject and the best methods of teaching it. No State school money shall be paid for the benefit of any district, city, normal, or other school herein mentioned until the officer or board having jurisdiction and supervision of such school has filed with the officer whose duty it is in each case to disburse the State school money for such school an affidavit made by such officer, or by the president or secretary of such board, that he has made thorough investigation as to the facts, and that to the best of his knowledge, information, and belief all the provisions of this act have been faithfully complied with during the preceding year.

"SEC. 2. This act shall take effect August first, eighteen hundred and ninety-five."

Thus it comes to pass that Indiana is at last in line with her sister States, and her children shall no longer be ignorant of "scientific temperance," if text-books can give them knowledge. And

it seems that text-books must do so, for nowhere else in the world can this kind of knowledge be obtained.

What is "scientific temperance"? What it is not we know from the above quotation from the ill-fated Indiana physiology. A strong statement of the reasons for abstinence from the use of stimulants and narcotics evidently does not suffice. Whatever of science or temperance may be in the Indiana series, it is clearly not "scientific temperance," else these years of agitation have been in vain.

To decide what "scientific temperance" is we must do as the children do. We must turn the leaves of our text-books till we find the answer; for "scientific temperance," like "Christian science" or "manly art," is not an expression which defines itself. To find a definition we must go to the source of information. Let us, then, select a series of physiologies approved by the leaders in the movement for "scientific temperance"—books in undisturbed use in States more fortunate than Indiana.

Our Bodies and How we Live is one of the best written books of the class in question. We learn from its preface that "the author and publishers are under deep obligations to Mrs. Mary H. Hunt, the Superintendent of the Department of Scientific Instruction of the National Woman's Christian Temperance Union, who has carefully revised the book." There is therefore no question that we have the right book for comparison with the Indiana series.

That which first impresses us is the strange new censorship which is imposed on scientific teaching. We find, to quote from the unpublished letter of a friend, that—

"A small group of people who have no scientific education or training in general, and not the slightest training in the specific science of physiology, one of the most complex and difficult of sciences, manages to become the dictators of both the matter and methods of teaching of this science in almost all the States of the Union. They do not profess to control this teaching for the sake of advancing the science of physiology or of the intellectual advancement of the student, but for the promulgation of a specific reform. This reform is no more naturally connected with physiology than it is with history. The effects of alcoholic drinks on the history of the country could be traced with more clearness and more reason than its effects on the bones. How is it that history has escaped?"

In this case physiology is used as the name under which attacks on the use of alcohol are brought into the schools. There is a science of physiology, a science which treats of the life action of cells and organs, but this science has scarcely found its way into our system of education. It has been obscured by the igno-

rance of text-book makers who have never heard of its laws and principles. It is obscured by the popular demand for its association with hygiene. The knowledge of rules of health is most valuable, but it is not physiology. The real bases on which such practical generalizations rest are never simple, and in most cases they are beyond the reach of elementary text-books. The rules of health ordinarily given are not deduced from physiological laws. They are rather the expression of the experience of the race. Their introduction into books on physiology is perhaps justified by their utility. But their presence interferes with the development of the science. In an ideal educational arrangement hygiene will have a place to itself, and will not crowd out physiology any more than it will chemistry or physics. The anti-alcoholic material demanded in "scientific temperance," in all its various grades, takes all form of scientific impartiality away from the discussion of hygiene, while physiology being mere science is crowded out altogether. In the book in hand all proportion of parts is lost sight of, while the effort to teach physiology as science is virtually abandoned.

If physiology is not wanted in the schools, let us give it up. But if hygiene is to be substituted, let us have it from pure sources. The rules of health should come from those who have made them a life study, using the methods and tests of science. If temperance is the sole important part of hygiene, let us again demand the words of the highest authorities. Let us incite to sobriety by the words of soberness, not by the battle-cries of the Crusaders.

By casting aside the orderly development of the science of physiology we may find place anywhere in our text-books for discussions of alcohol and its effects. In Our Bodies and How we Live we find sixty-seven pages devoted to it out of a total of four hundred and twelve. The corresponding book of the Indiana Series has but two pages in three hundred and one. And in the former work this matter is not gathered together in one place, where it might be disposed of in one lesson, or even omitted by the evil-minded teacher, but it is diffused throughout the book, so that no topic or discussion is free from allusions to it. In no part of the volume can we escape from the contemplation of the ravages of alcohol.

For example, we have in the description of the bony framework (page 40) a discussion of "the effect of alcohol and tobacco on the bones," as follows:

"Since the bones constitute the framework of the body, a person's form depends upon the size and shape of his bones. The bones grow during childhood and youth; whatever growth one loses during that time can not be afterward made up. It is the

testimony of sagacious physicians that alcoholic drinks and tobacco tend to check the growth of the bones.

"The smoking of cigarettes is especially hurtful to growing boys, because such a habit tends, besides other harmful things, to dwarf the growth of the bones. A well-developed form is something to be prized. No wise boy or girl will risk attaining it by indulging in filthy or injurious habits while young."

Under Physical Exercise (page 68) we have:

"THE EFFECT OF ALCOHOLIC LIQUORS AND TOBACCO ON PHYSICAL EXERCISE.—The main object of physical exercise is to get our bodies into such a condition, and to keep them in that condition, whereby the average amount of working power can be utilized at any time without harm to the bodily health. To keep up this amount of physical power and endurance we must be obedient to certain great laws of health.

"One of these laws, which never can be violated with impunity, is that which forbids the use of alcoholic liquors and tobacco. Strong drink and tobacco will put to naught the most elaborate system of physical training.

"Those who train athletes, baseball and football players, oarsmen, and all others who take part in severe physical contests understand this, and rigidly forbid their men to touch a drop of alcoholic drink, or even to smoke or chew tobacco. Experience has proved beyond all doubt that strong drink is a positive injury, either when men are in training for or undergoing contests demanding long-continued physical endurance.

"The same law holds good in the ordinary physical exercises of everyday life. Alcohol and tobacco act as poison to the nerve force which controls the muscles, and thus lessen the amount of muscular power and endurance.

"The demands of modern life call for a sound body rather than a strong body. Neither is possible to those who indulge in alcoholic drinks or tobacco."

In like manner, at the end of every chapter, the effect of alcohol and tobacco, like the refrain of a song, comes in to recall the real motive of the whole. There is a long and essentially accurate account of the origin and formation of alcohol. Another chapter gives experiments to be performed with this fluid. At the end of the book, in an appendix, are twenty pages of notes, collected from all sorts of authorities—some good, some doubtful, some worthless—"concerning the nature and effects of alcoholic drinks and other narcotics." A strong case is there made against these evil agencies, and no testimony in mitigation is allowed or even hinted at. For easy reference the following table of the chapters on alcohol is given (pages 329, 330), which shows the thorough saturation of the work with the alcohol idea:

1. The Bones (chap. ii, p. 13).	Effect of alcohol and tobacco on the bones (35).
2. The Muscles (chap. iii, p. 42).	1. Effect of alcohol on the muscles (44). 2. Effect of alcohol on strength (45). 3. Effect of tobacco on the muscles (46).
3. Physical Exercise (chap. iv, p. 56).	Effect of alcohol and tobacco on physical exercise (58).
4. Food and Drink (chap. v, p. 70).	Effect of drinking tea and coffee (72).
5. Origin and Nature of Fermented Drinks (chap. vi, p. 81).	1. Change produced by fermentation (74). 2. Ferments and what they do (75). 3. Alcohol a poison (76). 4. Narcotic poisons (76). 5. The alcoholic appetite (77). 6. The evils of overdrinking (78). 7. Wine, and why it should be avoided (79). 8. Beer: Its origin. Relation to drunkenness (80). 9. Distilled liquors (81). 10. The cost of the alcoholic vice (note, p. 89).
6. Digestion (chap. vii, p. 92).	1. Effect of alcohol on the stomach digestion (99). 2. Effect of alcohol on the liver (100). 3. Effect of tobacco on digestion (101).
7. The Blood and its Circulation (chap. viii, p. 122).	1. How alcohol gets into the blood (117). 2. Effect of alcohol on the circulation (116). 3. Effect of alcohol on the heart (119). 4. Effect of tobacco on the heart (120).
8. Breathing (chap. ix, p. 142).	1. Effect of alcohol and tobacco upon the lungs (132). 2. Alcohol and the bodily heat (133). 3. Alcohol in hardship (note, p. 160).
9. How the Body is Covered (chap. x, p. 161).	Effect of alcohol and tobacco upon the skin (145).
10. The Nervous System (chap. xi, p. 177).	1. Narcotics (162). 2. General effect of alcohol on the nervous system (163). 3. Effect of alcohol on the brain tissue (164). 4. Final result of alcoholic poisoning (165). 5. Inherited craving for alcohol (166). 6. Tobacco and its use (167). 7. Evil effect of tobacco (note, p. 203). 8. Effect of tobacco upon young people (168). 9. Tobacco from a moral point of view (169). 10. Opium (170). 11. Practical hints about opium (171). 12. Chloral and other poisons (172).
11. The Special Senses (chap. xii, p. 210).	Effect of alcohol and tobacco on the special senses (196).
12. Excretion (chap. xiii, p. 235).	Effect of alcohol on the kidneys (202).
13. Throat and Voice (chap. xiv, p. 243).	Effect of alcohol and tobacco on the throat and voice (207).
14. Simple Matters of Everyday Health (chap. xv, p. 249).	Pernicious use of alcoholic liquors in accidents and emergencies (225).

This, then, is "scientific temperance"—a work on human physiology transformed into a pamphlet or argument on the evils of stimulants and narcotics, with such incidental science as will strengthen this argument or secure for it a place in the schools. It is not enough that the case against these agencies be put briefly and strongly, it must be reiterated until it becomes the central object for physiological study. This makes a necessity for space-writing such as that above quoted. In the two pages of the Indiana Series I find twenty-one distinct ideas as to the evils of alcohol and tobacco. These it is the work of the teacher to illus-

trate or to dwell upon as he sees fit. No additional strength comes from dilution or repetition. Still less do the gigantic reasons why men should lead sober lives gain from association with arguments based on doubtful observations or spurious interpretations. In the sixty-seven pages of the other book I find about sixty different ideas, many of these not relevant to the subject in hand, the space being filled by repetition, quotation, and padding. Apparently this was not the author's original plan. It was forced upon him by the demands of the trade. A single collective paragraph, for example, would have covered the known effects of alcohol on most of the tissues; for alcohol does not affect the bones in one way, the muscles in another, and the stomach in a third. It confuses the nerves and poisons the blood, and these influences show themselves variously. The effects that concern us most are not the changes of tissue, but the changes of life.

Such a treatise as the New York law contemplates can not be written by a scientific man. The inclusion of "scientific temperance" in the course of study means the disappearance of scientific physiology. "It is insisted," says the writer from whom I have already quoted, "that in it shall be taught certain effects of alcohol on certain tissues and organs, when it is not known that such effects occur, and when some of them are known not to thus occur. Extravagant statements are demanded when only the most moderate ones can be made. If alcohol and its effects are mentioned at all, the true scientific spirit would demand that the whole truth and that only be told. This can not be done to meet the approval of the committee of censorship. These people demand this most monstrous thing, that there shall be a law compelling a scientific author in treating his subject to devote a certain prescribed amount of his space in such and such a way. They demand a large introduction of matter into the treatment of a subject that is wholly irrelevant to it. Indeed, they have the effrontery to demand of a scientific author in treating a certain scientific subject in the school courses that he shall introduce only so much of the subject as shall bear on a certain reform that they are advocating. Can even earnestness of purpose or the importance of the reform be a shadow of an excuse for such a course?"

The primary purpose of science teaching is to give not virtue but strength. The strong mind forms its own precepts of right action. The weak mind fails, whatever its memorized precepts. The methods favored by the advocates of scientific temperance must always fail of their purpose. No impulse to virtue is less effective than memorized statements of the evils of vice. Information learned by heart is never vital, least of all that which is given on doubtful authority, by methods not sanctioned by pedagogic experience. If such educational methods really led to tem-

perance we might overlook their less desirable results. But the youth can not be made virtuous by sentimental gush nor by scientific bug-a-boos. Just in proportion to his ignorance of the subject will be the teacher's willingness to undertake the teaching proposed by the New York law. Hence arise the penalties laid on teachers and trustees, a thing unheard of in relation to any study that justifies itself.

As already stated, it is evident that the value of the study of physiology is weakened or destroyed by neglecting its scientific aspects and by throwing its conclusions out of perspective. We might as well ask that our histories of the United States should devote a fifth of each chapter to the effect of the spoils system on the events described. The spoils system is to our politics what alcohol is to our bodies, and a wonderful field would be open to reformers if their doctrines could be forced into all historical text-books. And if one class of reformers is admitted, there would be room for many others. It will not be long before we hear from the Baking Powder people, while the manufacturers of oleomargarine will claim the ear of the schools for their product, which is free from the microbes of tuberculosis that infest the dairies. In so far as science yields the basis for any class of reforms, let the facts be known. But these demands should stand in clear relation to the facts on which they depend. Injunctions to temperance may be derived from scientific knowledge; but science should not be distorted for purposes of argument. Confusion and verbiage add nothing, and the teaching of positive untruths works constant injury to the cause of education.

The success of "scientific temperance" legislation, in spite of the combined protest of all intelligent teachers, is really not surprising. It is pressed mainly by committees of women, and by women who are very much in earnest. Politicians are always glad to humor women when a sop like this will serve to do so. So long as nothing substantial is asked for they are wonderfully complaisant. The mercantile interests have no objection to laws of this sort, which can in no way harm the liquor traffic either present or future. If the temperance movement spent itself in such ways only, it could count on the help of its enemies. The opposition to "scientific temperance" comes mainly from theorists who regard meddling of this kind as outside the province of good government, and from teachers who know by experience that text-book virtue enforced by penalties works only mischief in the schools. The more stringent the penalties on teachers and school officers, the more certainly do such influences fail as agents for good.

The whole matter has been thus strongly stated by Dr. J. G. Schurman, President of Cornell University, referring to the New

York law: "We find that all who are in any way engaged with the practical work of education have a protest constantly against the multitude of subjects which would-be 'reformers,' 'cranks,' and 'faddists' would require our boys and girls to study in the schools. If they get their way, the mental energy of our children would be dissipated and education become a sheer impossibility. The most fundamental of all reforms at the present time is the limitation of the number of subjects taught to any one student, with distinction between what is fundamental and what is subsidiary, in order that the short time which the young people of the country can devote to study can be put upon the most important and fruitful subjects. You hear people say every day, 'Is it not a shame that children should grow up in ignorance of this, that, and the other subject!' whereas the truth of the matter is, that it is in most cases an advantage that pupils have heard nothing of the matter.

"When I pass from the general principle of this law to scrutinize its details, it shows itself absurd on the very face of it. If there is any one thing which scientific teachers require at the present time, it is that students of science shall not be taught from text-books. In the programme of many of our best schools (I do not mean colleges or universities) the use of the text-book in science is absolutely forbidden. The 'reformers' who desire the legislation under consideration prescribe a text-book; and not only so, they tell the teachers how many pages are to be studied in order that students may understand 'the nature and effects of alcoholic drinks and other narcotics.' It would be a great reflection on the educational wisdom of those who are responsible for making our laws if a conception of scientific teaching so wooden, so utterly mechanical, were ever to find a place in our statute books. The scientific teachers of the country, whether in the public schools or in the colleges and universities, would justly hold us up to ridicule."

In the same vein Dr. William R. Huntington, rector of Grace Church, says: "As a member of the Committee of Sixty, charged with the investigation, from a scientific and impartial standpoint, of the whole question of the relation of alcoholic stimulants to the animal economy, I have been in the way of hearing the educational phase of the subject very fully discussed, and I am convinced that the attempt to indoctrinate the minds of the youth of the country in the premises, though well meant, has been overdone. Let the children be taught the perils of drinking and the horrors of drunkenness as emphatically as you please, but let us not palm off on their innocent minds pseudo-chemistry and inaccurate physiology as necessary truth."

Every institution tends to magnify itself, and the need of a

reason for existence leads it to try to show results. Hence the unwillingness of the advocates of "scientific temperance" to let well enough alone. From two pages out of three hundred they have come to insist upon sixty pages out of four hundred. But this will not satisfy. Sooner or later the whole must be conquered. With every additional page taken from science for temperance, they have the basis for a show of results.

"The natural result of the dictatorship of unscientific people over a scientific subject is that they require all sorts of the most absurd things. Their success with legislatures has made them arrogant and oppressive in the extreme. These women certainly must be in earnest to be willing to assume to control for the whole country the teaching in the schools of a subject in which they do not profess to be trained; to assume to dictate to those who have made a certain science their life work what they shall and shall not say on this subject; to be willing to see, indeed to put in motion the machinery which brings about, a form of legislation which further developed would turn the public schools into an instrument which the smartest politicians who could capture them might use to further on any true or false reform or visionary scheme."

The only remedy for such meddling lies in allowing that science shall be free to teach its own lessons, and that the public schools shall not be used by advocates of any kind of social or political reform, no matter how meritorious the cause may be in itself.

The whole "scientific temperance" movement is opposed to the movement for good schools through the choice of good teachers. It has been judged thus far mainly by its motives, which are good. It will come to be judged by its results, and these are bad.

In his estimate of the age of Niagara Falls, Mr. J. W. Spencer assumes that the authors of the later computations have failed to take sufficient account of the factors that have caused the rate of recession of the cataract to vary, and of the consequent variation. He has newly examined the channels of the river and the geological evidences they offer, and has incorporated the results in his estimate. He finds that at the nativity of the Niagara River there was no fall. Then the waters sank to the level of Iroquois Beach, and the falls were very much like the modern American cataract in height and volume. This afterward increased in volume and went through a number of changes that are detailed in the author's paper. His computations result in the conclusion that the falls are thirty-one thousand years old, and the river is of thirty-two thousand years' duration. It is further roughly estimated that the lake epoch began fifty or sixty thousand years ago. If the rate of terrestrial deformation continues as it appears to have done, then in about five thousand years, Mr. Spencer thinks, the life of Niagara Falls will cease by the turning of the waters into the Mississippi.

THE GEOLOGICAL WORK OF THE AIR.

By M. STANISLAS MEUNIER.

SOME specimens recently received at the geological laboratory of the National History Museum in Paris suggest a study of the action of the wind in geology and of the importance, long overlooked, of wind deposits. The specimens are lavas from the volcano Mauna Loa, which the wind, lashing them before hardening, has reduced to fibers of extraordinary fineness. They might be called bunches of oakum. The mechanism of the formation of these—or Pélé's hairs, or bald men's locks, as they are poetically called—is similar to that by which similar formations are produced in furnaces when the blast is directed against the melted slags. It has been proposed to employ the product thus prepared as a textile material; but it is not well adapted to such use, be-

FIG. 1.—PÉLÉ'S HAIRS: VOLCANIC LAVAS SPUN BY THE WIND AND RESEMBLING TOW; FROM THE VOLCANO MAUNA LOA, SANDWICH ISLANDS. Natural size.

cause of frequent abrupt changes in the diameter of the vitreous threads. This peculiarity is shown in Fig. 1, where the little black tears mixed in with the brownish fibrous material are really the knots by which the filaments may at any time be interrupted. If we examine these bald men's locks with a microscope, we shall find the evidences of their wind origin more abundant. Fig. 2 represents them magnified fifteen diameters, and Fig. 3 one hundred diameters. We see in the former of these figures that, notwithstanding their coarse appearance, the filaments are anything but homogeneous in all their parts. The axial region of each of

them is usually marked by a sort of thread, either continuous or discontinuous, which sometimes suggests a cylindrical cavity, but is more usually in the condition of scattered granulations. The nature of these included bodies can often be determined with precision; and to select one of the clearest cases, they may not infrequently be perceived acting energetically upon polarized light as if they were true crystals, while they show geometrical forms on larger or smaller parts of their contour. On closer examination it is possible to refer them to grains of pyroxene. In some of the filaments the axial inclusions are of a different character; their perceptibly spherical form and other features identify them with the gaseous bubbles frequently observed in rocks. The

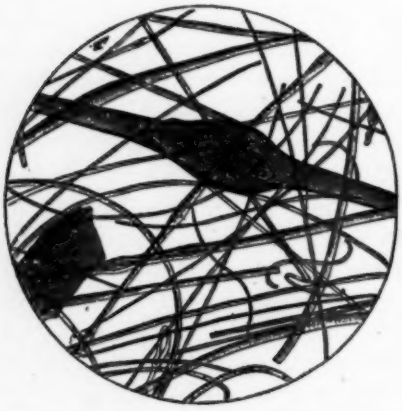

FIG. 2.—PÉLÉ'S HAIRS SEEN THROUGH THE MICROSCOPE. Magnified fifteen diameters.

FIG. 3.—PÉLÉ'S HAIRS SEEN THROUGH THE MICROSCOPE. Magnified one hundred diameters.

matter which fills the cylindrical cavity, often as long as the filaments themselves, is also gaseous; and so likewise are the bubbles that may sometimes be seen by thousands in the vitreous scales, such as are abundantly represented in an angular plate near the edge of Fig. 2. Another point to be noticed is the way the filaments terminate that we are sure have not been broken after consolidation. They are very rarely drawn out to a fine point without bending, but usually they suffer a more or less abrupt curve or are done up into a knot or a loop, of which Fig. 3 indicates some common forms.

If we lightly shake these locks above a sheet of white paper, a fine dust will fall upon it in which the microscope detects among the finest filaments myriads of brownish, translucent, and sometimes transparent, vitreous pellets. Most frequently they are perfectly homogeneous, but they also often contain inclusions similar to those in the filaments. The perfection of their spherical form is not strictly in proportion to their diameter, as might be sup-

posed; but some of the larger ones are very regular, and some of the smaller ones are more or less pyriform. Many of these are traversed by fine perlitic cracks. Together with the pellets are numbers of the vitreous scales which we have just mentioned. Some are perfectly smooth and uniformly transparent; while others contain bubbles and blisters, and have a rough surface. Sometimes innumerable little vitreous pellets are massed upon them, similar to those which form bunches like bunches of grapes on some of the finer hairs.

I do not think that the mixture of pellets with the slag threads spun accidentally near the nozzles of blowers in factories has been insisted upon. These little balls result from a special action of a gaseous medium; and it is important to remark that we can by their presence recognize the wind origin of the deposits that contain them. They have a bearing upon some observations of M. Gaston Tissandier, who has found similar globules in atmospheric sediments in very different localities.* These spherules have evidently originated from the action of the air upon the fluid matter developed upon the surface of meteorites during their passage through the atmosphere. They should be formed in considerable numbers at every fall of meteors, and their small volume is favorable to their remaining suspended in the air for a long time, and to their being carried by the wind to considerable distances. This explains the quantities of them found in the ocean bottoms. All marine sediments that have been carefully examined yield globules of this kind; and, as is shown by the common researches of M. Tissandier and myself, they were equally abundant in the ancient geological seas. Thus, to cite an example that has struck us very forcibly, the green sand extracted from the artesian well of Passy, at five hundred and sixty-nine metres below the surface, and which is of the Albian (lower Cretaceous, Potomac group), is full of spherules as perfect as those which are extracted from the dust that has accumulated in the towers of the Cathedral of Paris.

The mechanism of the production of these globules is rendered very evident by their abundance in certain industrial residues, especially in the iron oxide produced by hammering, and in the product of the combustion of iron in oxygen. Evidently the melted oxide spread into laminas by mechanical projection goes through the same capillary action as gives their form to soap-bubbles. We can study all the details of the phenomenon with greater facility if we have recourse to substances much easier to melt than oxide of iron. I have had occasion to do this with the experimental products which M. Daubrée has asked me to

* Les Poussières de l'Air. By Gaston Tissandier. Paris, 1877.

examine, and which have been formed in his investigations of the perforation of rocks by gaseous explosions. In these experiments, channels were opened through the granite by the gases of nitroglycerin, showing on their vitrified surfaces all the stages, from the drawing out of a thin pellicle of melted glass to the formation of a perfect spherule. Grains of two different categories may be distinguished with the microscope in the dusts produced in the trituration of rocks by the violent passage of gaseous explosions. Some can not be distinguished from those produced by simple mechanical pulverization. But, besides these materials—angular grains of quartz, feldspar, and mica—we find abundance of perfect, or nearly perfect, spheres, opaque and black or slightly translucent and brownish, with shining surface and often the characteristic little neck. Identical elements are found in the dust derived from different rocks that have been submitted to experiment, but with features that vary in each of them.

Dust obtained from the lava of Vesuvius exhibits the globuliform character in the highest degree. Nearly all the matter is in the condition of black globules of various dimensions, but always very light, and sometimes having a tubulure. The abundance of these globules is manifestly associated with the relatively easy fusibility of the rock, which is also represented in the constitution of the general glaze with which all the parts that have been in contact with the incandescent gases are covered. The identity of these globules with those that exist so abundantly in the atmospheric dusts and marine sediments can not be contested. Till now, says M. Daubrée,* the general opinion, and the only one possible, has been to connect the origin of these globules with the arrival of cosmic masses in the atmosphere; and we may add now to the arguments already presented in support of this thesis, the results afforded by the gaseous trituration of meteoric rocks. The dust furnished by a stone cylinder that fell from the sky in 1888, at Pultusk, was marked by innumerable globules, associated with fragments of peridote and entastite, and with metallic granules which had preserved their ramified form and their adherence to lithoid minerals. What we have said shows also that terrestrial rocks, as well as meteorites, may engender these globules. Hence the arrival of meteorites into the atmosphere incontestably contributes greatly to the production of the brilliant globules so abundant in aërian and aqueous sediments. It seems also to be established that the openings of diatremes † have an active part in

* Les Régions invisibles du Globe et des Espaces celestes (The Invisible Regions of the Globe and of Celestial Space). Paris, 1892.

† Cylindroid vertical apertures traversing the crust of the earth, of which the diamond-bearing *pans* of the Cape and volcanic chimneys furnish well-known types.

the matter. The spherules concomitant with the gaseous erosion of granites and other rocks, thrown up into the atmosphere to the great height reached by fine volcanic ejections, may be sustained in the air for a very long time, and fall to the earth at great distances. In support of this opinion it will be recollected that in the basins of seas, the corpuscles of which we are speaking, to which MM. Rénard and Murray do not hesitate to ascribe an extra-terrestrial origin, are generally associated with clearly volcanic products.

In order to elucidate completely the origin of the globuliform matters, I have placed melted wax in a pipette with a capillary end, and blown the jet into a vessel of cold water. The product had all the characteristics of the globules of which we are trying to explain the origin, some hollow and having little necks like the meteoric spherules, others full and joined together like the associated spherules in the bald men's locks in the crater of Mauna Loa.

The geological importance of atmospheric sediments is marked in these days in many ways. The facts with which we have been occupied will contribute to illustrate it still more.—*Translated for the Popular Science Monthly from La Nature.*

NEW OUTLOOKS IN THE SCIENCE AND ART OF MEDICINE.*

By T. MITCHELL PRUDDEN, M.D.

I WANDERED last summer over that marvelous land of sunshine in our great Southwest where still fast dwindling groups of the real Americans cherish quaint customs, and linger among the superstitions of vanished centuries. And Fortune made me for a time a guest in a small tribe of these Indians, as yet almost untouched by the blighting finger of what to us is civilization.

I was drawn to them in this way: There came to our camp upon the plains, one evening, a woebegone dark fellow of this tribe, who with his squaw had wandered away from his comrades, seeking a quiet place to die. He was wan and feeble. A demon, he told us, had long since gained entrance to his body and had tortured him with pain and cold and fire. All the art of his tribal medicine men had failed to free him from the intruder, and a little while before, some spirit had begun to whisper to him in his sleep, he said, that he must go into the dark. All this was gathered from lip and gesture and pantomime as he lingered with

* An address before the graduating class of the Yale Medical School at Commencement, on June 25, 1895.

us, loath to relinquish at the last the scant comfort of human companionship.

In the light of the lore which had been imparted to me many years ago by my medical teachers here at Yale, I reckoned him the victim of malaria; and shortly, in fact, quinine had cured him. The demon was exorcised, the spirit ceased to whisper, the sun was again his friend, and the winds began anew to breathe to him their wonted biddings to the chase. The grateful soul, now eager to be away, was urgent that I should visit his people, for he was fain to celebrate the facility of the white medicine man who could banish evil spirits without rattle, dance, or chant. And so I went. Eighty miles across the desert from any settlement, down at the bottom of a rock-walled chasm which leads into the Grand Cañon of the Colorado, and whose sides tower sheer half a mile, these brown-painted folks have lived alone and almost forgotten since long before the Spanish pioneers came hither for God and gold some centuries ago.

At the time of my visit several persons in the tribe were ill, and a celebrated medicine man had been summoned from afar in council over the stricken ones. After long and repeated conferences, my dark medical brothers consented to lay aside cherished forms of professional etiquette, and permitted me to take a place in the grave circle which at midnight crouched about a small fire built in the open, near which lay, half naked, the group of patients. One of these was clearly the prey of consumption; one was shivering with malarial poisoning; one was a croupy child; one I judged to have partaken unwisely and too much of spoiled jerked meat; and one was the victim of old age. I have not time to picture for you, as I should like to do, the weird scene which was enacted there from midnight until dawn, night after night. A low rhythmic chant rising and falling to the time of a rattled gourd; slow passes of the hands over the prostrate bodies, which now and again were blown upon from the pursed lips of the painted Æsculapius, who now crouched crooning beside his charges, now danced furiously about them, while at frequent intervals wild yells from the attending circle woke hideous echoes from the cliffs. I will not dwell upon the sequels of this adventure, but remind you only that the conceptions of disease which these people foster, and the practices which they adopt to free the body from what is to them a definite possession by some evil thing, are essentially those which were prevalent ages ago, and whose significance we glean so toilsomely to-day out of the misty and broken records of the past.

I have lingered in story on the threshold of this address, because I wish to emphasize the fact that in this country and to-day —in all countries of the world, for that matter—a large propor-

tion of mankind, consciously or unconsciously, personify disease or think of it as something foreign to the body, some definite or mysterious thing intrusive. From the painted red man of the plains, who associated his bodily ailments with demons, spirits of the dead, witchcraft, magic, evil possession, and angry gods, and hopes to banish these with shrieks and songs, it is indeed a far cry to the clean, clad, business or professional white man of the town, who more or less sheepishly confesses that he carries a horse-chestnut or a potato in his pocket to ward off rheumatism. But between the charm of the horse-chestnut and the chant of the savage lies a great body of ignorance and superstition, upon which quacks flourish mightily, and which can not be altogether ignored in any wide outlook to-day over the field of medical science and medical art.

In fact, the superstitious red man is much more reasonable and logical in his procedures for the cure of disease, considering the scope and character of his conceptions of its nature and the phase of civilization which he represents, than are large numbers of considerably evolved white folks who, in the midst of highly civilized and cultured communities, bow still at the altars of sanitary savagery, cherish a devotion to drugs almost pathetic, and utterly fail to grasp the significance of the new conceptions of disease which at last have made of medicine an exact science.

That which has especially contributed to the establishment of medicine on a firm and rational basis is the gradual centering of our thought and experiment upon definite and tangible structural features of the body, and the conviction that the physical nature of man is closely interlinked with that of lower forms of life.

In its primitive phases, medicine brought gods and men into close relationship and led constantly to religious conceptions. It was, in fact, not a science, but a religion. The early priests were physicians, the primal gods were gods of healing, and their temples were hospitals. As time passed, absorbing speculations, fantastic often, frequently grotesque, about the structure of the body and the nature of disease, won general belief and disappeared. Theories, systems, and schools came and went. Now mysticism and magic, now humors and philosophy, held sway. Quackeries and frauds flourished for their little hour, and vanished, as they always must. Finally, the body itself became the object of direct study, and the mysteries began to clear.

But it was a long time after it became reputable and legal to study the anatomy of the human body before the old physicians acquired a definite conception of it as an admirably grouped assemblage of tissues and organs. It took much longer for the development of accurate notions as to the functions and uses of

the separate parts of the human frame. And it was not until the early decades of the present century that science was able to declare the ultimate element out of which all these varied parts are built to be a tiny particle of living matter which was called a cell.

Somebody has said of Turner that he was a man who thought in paint. The modern devotee to medicine, if he seriously thinks at all, must think in cells. Physicians used to think in symptoms, and it took them a great many years to learn that they must think also in cells and organs—that is, with clear morphological conceptions—if they would crystallize for use the knowledge which experience brought them.

Through the long processes of evolution, these cells have acquired peculiar forms, and adapted themselves to the performance of special functions. The great cell groups—we call them liver, lung, brain, muscle, bone—each doing its particular work, all act in harmony for the maintenance of the life and performance of the body as an independent being.

We do not yet understand, nor shall we soon, what that marvelous vivifying influence is which sets this self-built cellular mechanism at work, and keeps it going, as a rule, under favorable conditions until the shadows of threescore years and ten begin to deepen about the worn machine. Nor has all our gathered life lore led us far among the mysteries which cluster about the vague region in which the spiritual and the material meet and interfuse. But this we know, that all the things the body does, from its high borderland achievements in thought and memory down through the homely processes of nutrition and repair, are accomplished by these small life units in accordance with physical laws as definite and unvarying as are those which we trace in plant and earth and star.

Under a variety of adverse conditions the human body can still hold its own and secure for a time a certain degree of health, thanks to the adaptability to circumstances of its component cells. Thus, by the nice control of its ceaseless chemical processes, the body can maintain a nearly uniform degree of heat, no matter what the latitude or season. Starve the body, and its cells can feed for a while upon the stores which they have in times of plenty laid aside. They struggle long and faithfully against the manifold excesses which may be forced upon them. They fight with fashion, in one sex at least, for space within this none too roomy tabernacle, with business and with pleasure for a time to rest, with drugs and blighting drinks and unwholesome foods for release from poisons which it is not usually thought criminal to administer to one's self. They work as best they can without the wholesome air so frequently denied them. They resist with what force they can muster inherited weaknesses or taints.

But after a time, when the conditions under which the cells live and work are definitely unfavorable, they may fail to maintain the standard. Their performances become faulty or feeble, or, with their structure, may largely change. If carried beyond a certain limit, these weakened or perverted functions and their attendant physical changes constitute the condition called disease.

In fact, science does not now permit us to forget that "the living body is a mechanism, the proper working of which we term health; its disturbance, disease; its stoppage, death." The happy condition known as health does not commonly draw attention to itself, and so has escaped personification; while the other conditions—disease and death, strictly its analogues—from the earliest times have been invested with such mysteries as among all people have led to misconception and to figurative speech.

I wish especially to emphasize the simplicity of the modern scientific conception of disease as a disturbed condition of a complex cellular mechanism, because it is largely due to a failure to comprehend this that the shadows of the middle ages actually still lie dark over certain of the popular conceptions of medicine, and seriously retard the speedy fruition of many of its new discoveries.

The practical ends which have been of necessity held in view by the devotees to medicine, the bald empiricism through which most of the therapeutic resources of our art were won, and the stubborn persistence of old and misty conceptions of disease have greatly hindered the realization of the fact that medicine is, after all, only one phase of the great science of life which we call biology, and that its varied themes must be pursued by the same methods and under the same strict safeguards against error in observation and in inference as are current among those who study science in its simpler aspects. It may make some practical difference that the particular animal to which the medical man devotes his time is highly complex, fosters a soul, has a future, and pays in cash (sometimes) the expert who can relieve it from discomfort or pain and prolong for a little now and then the cellular confederation. But if we do not constantly draw light from the common sources, we shall wander hopelessly in empiricism and fail at last. In truth, to strive for wide comprehension of the human frame without the constant aid of sister sciences and frequent reference to simpler forms and functions is but to build upon the surfaces.

Permit me now in a somewhat desultory fashion to glance with you at two or three phases of recent development in medicine. I have not wished to frame an exhaustive inventory of our gains, but rather to note such features as can be led to wider be-

neficence through forces which we may ourselves administer as we go about our usual tasks.

When we group diseases according to causation, we find that many are due to excesses—excesses in food, in drink, in drugs, in exercise, in indolence, in work, in rest, in play. Sometimes the body labors under adverse influences which we do not understand. Sometimes the organism is handicapped from the start by inherited defects. Sometimes subtle poisons which the body itself forms are not properly disposed of, and the organism suffers.

In spite of the vast stores of experience with the human body in disease, clear down to the early part of the last decade, the nature and cause of some of the most common and fatal human maladies were practically unknown. I speak of the diseases which we call infectious. These were so widespread and so mysterious as to foster superstition, and lead to the perpetuation of the earlier notions about angry gods, offended Providence, judgments, warnings, witchcraft, and so forth, long after the legitimate presence of such developmental phases in human thought had passed away. Man had gone on making up inventories of his visible life neighbors in the world, had traced their pedigrees and relationships, had found how closely their evolution was bound to his own, and had got the systems pretty well completed, when his surprised attention was called to an inconceivably populous world of beings lying far beyond the reach of the unaided vision and closely woven into the chain of life. And shortly the so-called "germ theory" of disease had ripened into a well-grounded body of positive knowledge, so far-reaching and significant that more than anything else it has seemed to dominate medical science for more than a decade, and has led to most beneficent practical results in the prevention and the cure of disease.

For a good while after attention had been called to the existence of microbes, most people thought of them—many still do—almost exclusively as inciters of disease. But this is a most narrow conception. The amount of material on the earth available for the temporary uses of living things is limited, and it is largely through the intervention of these lowly but active organisms that when once the material, which for a little while has come under the sway of the life forces, has fallen into death, it is rescued and worked over into available life stuff again. And so, chained over to the material, the cycle of life on the earth is maintained only through these swarming hordes which serve all animate things in serving their own necessities.

We can to-day trace their presence through geologic ages, sharing in the life of earlier times. We are but just beginning to realize their vast economic importance in agriculture, in the vine-

yard, the dairy, and the kitchen, in certain of the arts, in the normal processes of digestion, and in the maintenance in many ways of the salubrity of the earth and air and water.

The sooner we realize that the exercise of their disease-producing powers by the microbes as a class is only an incident in their largely beneficent careers, the sooner shall we arrive at a just comprehension of our newly discovered earth neighbors, upon whose ministrations we are dependent for the creation and the maintenance of conditions which make possible our being here at all.

The variety and complexity of the chemical transformations which microbes effect in the soil and in the water are but just becoming evident. But we already know that through the vast reaches of time which their life history covers the delicate work which they have to do has been intricately apportioned among them, and a most elaborate physiological division of labor adjusted. The struggle for existence among these lowly forms of life is so keen that they are almost always confined to their legitimate haunts and to their beneficent offices.

I need not refer in detail to the story of the discovery, one after another, of the bacteria which have been shown to cause fatal maladies. Tuberculosis, cholera, pneumonia, diphtheria, tetanus, anthrax, and more of the sinister brood have now yielded the secret of their causation.

At first the relationship of bacteria to the diseases which they were found to cause seemed quite simple. But as research went on it became clear that we were still only scanning the surface. It was shown that these intruding germs do not act chiefly by their mere presence as foreign bodies, but more usually or more fatefully by the elaboration of subtle poisons which permeate the body and destroy the cells or disturb their nice adjustment.

So the study of the products formed and set free in the life processes of these germs opened a new line of intricate and delicate chemical procedure. Think of the complexity of the processes which are induced in the body by the presence and action of these living organisms! We have, on the one hand, the body cells, each one, small as it is, a chemical factory, setting free unnumbered complex substances, some of which are to be used by the body as a whole, some to be resolved into other forms, some to be eliminated, since they are powerful poisons. To these multiform cell units of the body enter the germs, cells too, mostly plants, equally complex in their processes, also poison factories sometimes of most appalling energy and grown hardy through ages of strenuous battle for existence.

Great progress has been made in research upon the agencies which the body can bring into play to protect itself against these

sinister intruders, and did time permit I should like to call your attention somewhat in detail to the mimic warfare which is maintained, often in extreme hazard, under conditions which belong especially to modern life.

There are still several tissues and organs about whose uses we are, in the main, ignorant; but there is much reason for the belief that several of these unknown mechanisms are largely useful in disposing of or rendering harmless numerous poisonous substances which in their complex metabolisms the varied body cells set free; and the recent revelations in the relationship which microbes bear to disease have made it seem probable that the agencies which the body has developed for its own protection against itself are the same agencies which it employs to protect itself against these small invaders.

We have learned of late that not infrequently more than one germ species may be at work in producing the cell disturbance which we call disease, and that an individual whose inherent protective mechanism promises a favorable outcome to the fight when one enemy alone is within the citadel, may speedily succumb upon the entrance of its allies.

It has been shown that the same germ, under varying conditions, can induce maladies hitherto thought to be different; so that the number of our unseen enemies in this silent realm may, as our outlook becomes more commanding, prove to be smaller than we have been led to think.

Several of the most fateful germs are constantly with us, especially in towns, but doing no harm, unless through some breach in the complex and curious line of the body's defenses they enter the sanctuary. Even then they are often harmless, as we have seen, except in an organism whose defensive mechanism is already weakened by excesses or disease.

The extreme rapidity with which these organisms multiply has made it possible to study experimentally, in the countless generations which come and pass within the range of a single experiment, the effect of environment upon their morphological and biological characters, and the existence of races and varieties within the limits of what we are pleased to call bacterial species has been well established.

It has been possible by changes of environment to so alter the metabolism of disease-producing germs that, though apparently growing as vigorously as ever, the poisons by which their evil effects on man are caused have lost their power. In fact, we now know several germs quite similar to those which are of most sinister import to man which, apparently, under what we call natural influences, have lost their power to harm. These are some of the lines of study with which bacteriology to-day is busy.

But the greatest immediate practical benefit derived from the new knowledge of micro-organisms is the certainty with which some large groups of infectious disease can be controlled by private and public measures of sanitation.

Of course, in sanitation, as in other phases of morals, it is not as easy to do as to know what 'twere well to do. But it is safe to say that if we were ready in this country to follow such dictates of science in sanitary measures as are of known efficiency, we could secure their birthright of long life and health to a large proportion of that forty per cent of all the people who, as statistics show, are now destined to perish from preventable infectious maladies.

The means by which individuals and health boards may realize the possibilities for human weal so clearly indicated in the newly won lore of preventive medicine I need not here recount. They are easily enough learned as soon as the conviction of their importance has grown to a fixed purpose of action.

The scope of this address does not permit me to dwell upon the really wonderful degree of accuracy with which the educated and experienced physician of to-day can detect abnormal conditions in the varied cellular structures of the living body, nor upon the clear conception which he may acquire of morbid states and processes in situations physically inaccessible. He can recognize what groups of hidden cells are faltering in their work, are struggling under burdens, or in what way the co-ordinating mechanisms are failing in their tasks; and now in one way, now in another, and not most often with drugs, as so many think, can he tide the halting mechanism over its hour of stress. The cause of the disturbance may be removed, rest secured, pain assuaged, perverted function set right, and even for a time the aged, worn-out mechanism encouraged to prolong its task. And if the physician can not so frequently as we would wish guide to the happiest issue the healing forces over which the human frame has gained control, it is certain that, other things being equal, his success is assured just in proportion to his accurate practical knowledge of the delicate mechanism which he is seeking to repair, and his comprehension of the nature of the life forces which he must in the right way and at the right moment aid, and with which he must as certainly not unwisely interfere.

In these hurried glimpses of only a limited phase of medicine, it is most significant that there is no talk of humors and auras and vital spirits, nor of illusive and intangible fancies such as for centuries held sway in fields once ruled by demons and angry gods, but of definite things which we can see and handle and measure. Herein, to my thinking, lies the heart of our achievement and the brightest promise for the future.

But while our science and our art are now steadily growing in precision and usefulness, our practical accomplishments are greatly limited, because general enlightenment regarding the things of the body has not kept pace with the acquisitions of science.

Our new outlooks in preventive medicine have made it plain, as I have said, that a very wide curtailment of suffering and a large saving of human life are possible if only the people can have an elementary knowledge of the human body and of such simple principles of hygiene and sanitation that under the increasingly complex conditions of modern life they may be able to guard against common forms of infection and against unwholesome modes of life, which not only invite infection, but many other forms of ill.

It seems to me that here the schools and the colleges have high responsibilities, and of these I wish briefly to speak.

The conviction has for some time been current that the children should be taught something about the structure and working of the human frame, and in this way already much has been achieved. Of the importance of this sort of knowledge no special demonstration is needed to-day. But in many of the public schools in this land the instruction in physiology and hygiene has been of late largely subordinated, if not actually falsified, to the interests of what some are pleased to call temperance; meaning thereby the avoidance of alcohol and tobacco, lest horrible and frequently impossible things should happen to the liver or the brain.

But I think that the distortion of truth is not liable to lead at last, no matter how worthy the motive, to the ends for which the anti-alcoholic and anti-nicotinal physiologies and hygienes of our schools have been devised. It seems to me certain that a great deal of the future physical and mental well-being of our people depends upon the acquirement early in life of absolutely accurate, though it be rudimentary, knowledge of this complex and sensitive bodily mechanism; and that the self-control and self-respect which such knowledge fosters will in the long run do more than vague fear of bodily ill to promote a temperance much more comprehensive and beneficent than that which centers itself in the avoidance of alcohol and tobacco, bad as the misuse of these may be. It is to be hoped that mistaken zeal in this direction may not long prevail to the physical and moral detriment of the children.

Many of our institutions for higher education now recognize the value of a knowledge of the body, and of the physical conditions under which man can best secure the highest usefulness and enjoyment. But I do not think that as yet this subject has re-

ceived attention at all commensurate with its vital bearing upon the well-being—spiritual as well as physical—of those whom the universities equip. So long as a knowledge of the human frame was looked at from the standpoint of the dispenser of mysterious drugs to a mysterious organism for the purpose of expelling mysterious foes; so long as the body was regarded chiefly as a more or less disreputable tabernacle for the temporary uses of the soul; so long as its harmonious and significant relationship to other forms of being lay largely beyond our ken; so long, I say, as all these conditions prevailed, accurate knowledge of the body and the factors necessary to its physical well-being did not command attention in the higher educational outlooks.

The equipment which I urge is in no sense medical, nor is it such as encourages the fancy to linger upon trivial ailments or inspires the dread of disease. For it should be remembered that the fundamental facts of anatomy, physiology, hygiene, and sanitation do not belong particularly to medicine, as is too often hastily assumed. This knowledge is indeed especially useful to the physician, and upon it he builds up into the domain of medicine. But it is a part of the common stock of world lore. And I do not think that there are any forms of provisional knowledge among those which candidates for admission to the colleges are required to possess more important than this.

Nor can I regard any schedule for the higher education, no matter what the calling to which it is initiatory, as adequately comprehensive which does not embrace definite and well-balanced instruction in the more advanced knowledge of the human body, its relationship to other forms of being, and the means through which it best can serve those larger purposes of life which the university inspires. One often marvels at the pitiful ignorance of the body and of the simplest principles of healthy living common among learned and cultured men and women to-day. Ashamed not to know the origin of a word, or to fail in the comprehension of a literary allusion, masters in theology, wise in the law, keen in business, versatile and brilliant in society, they are prone to court disaster in senseless modes of life, and fall easy victims to charlatans and unscrupulous drug venders—an association which they share with the illiterate and uncultured in a fashion highly democratic, and which suggests the survival of traits less incongruous and much more picturesque in the North American Indian.

Our new outlooks in medicine have not been won without toil and sacrifice on the part of its devotees, and these will still be necessary. But it is evident that in the medical colleges there must now be fuller endowment of research and more adequate provision for instruction, not only in the traditional themes of

undergraduate study, so largely expanded, but also in recently developed disciplines.

The clear appreciation of the close relationship of medicine to other phases of biology; the newly recognized importance of practical familiarity with things themselves, rather than with the impressions which another has gathered and more or less lucidly imparts; the patient training of the hand and eye and ear to catch minutest variations in surface and color and shape and sound—all these requirements of modern medical instruction involve pecuniary support far beyond that which was formerly sufficient.

As was to be expected, the necessity for improvement in the medical curriculum and the urgency of the requirements of research have been recognized at this university in the revision and expansion of its medical course. And it is to be hoped that the appeal for endowment of the medical school here at Yale, made in the President's last report, may not go unheeded by those who are now for a little while the custodians of wealth, and in whose power it is to bring into play facilities for instruction and capacities for research so full in the promise of immediate practical utility.

What, now, is the attitude of the physician, in the light of the broader and more exact science which is to-day at his disposal? It may be at once conceded that his physical presence has mainly lost its old-time picturesqueness.

It is inevitable that as soon as he laid aside the mysteries and fictions and superstitions with which erstwhile he was wont to invest his calling, was obliged to abandon charms and auguries and secret remedies, and could no longer safely summon to his aid the occult forces with which outgrown fantasies invested plant and mineral and pregnant aspects of the stars, and was forced to confess that in dealing with his charges he was even, as other devotees to other sciences are, simply a student of common things with the simple resources of actual knowledge and common sense —it was under these conditions, I say, inevitable that his claims to confidence must more definitely rest upon his sound learning, his obvious skill, his actual experience.

A large part of the late surviving professional mannerism and dictatorial assumption has also passed away, and the doctor of to-day is a man of the world, the friend as well as the expert.

It is a very wide-eyed generation which is coming on the scene, and not prone to invest with unnecessary ceremonial or mystery the dealings of its professional advisers with its ailments. Many laymen know as well as we do that the administration of drugs in their hour of stress is but an adjunct to the often more needful and more potent guidance in diet, in regimen, and in the varied

general measure by which the stricken organism may be nursed back to health.

And if we mumble and shift as we face legitimate inquiry as to the nature of disease and of remedial measures, and strive to foster the old conception of the body's hidden mechanisms as of a "strange internal kingdom of which we are the hapless and helpless monarchs," we surely can not justly protest if the baffled inquirer turn to the charlatan.

While in many cases the patient is so ignorant, so heedless, so indifferent, so little in control of his mental outfit, that the simple dictum of the doctor may convey all that is wise, it is still, I think, true that usually a clear and simple explanation of his condition and an enlistment of his intelligence, or that of his friends, in the nature of his malady and the measures proposed for its removal, not only often contribute to success, but also, on the part of the physician, are more dignified and more humane.

But, beyond this phase of helpfulness, the physician has the largest opportunity in his intimate dealings with his charges to so counsel and instruct that, especially in the routine of household life, the fundamental principles of healthy living may be understood and followed.

I am aware that to many physicians this is now the accustomed way; but it might, I think, wisely be the way more often trod.

Again, the practitioner of medicine has facilities for fruitful research to-day, however simple or obscure the field of his activity, such as no earlier time has realized—because our problems are more precise, our methods more exact, and opportunity for interchange of thought abundant.

There is, indeed, no better example of the scientific method of research than the performances, physical and mental, of the well-equipped physician as he stands in the presence of this delicate mechanism faltering in its tasks. He summons his facts—by story, by test, by observation; frames from them, in the light of all the lore which he can muster, a clear conception, or a theory if you will, of the cause and nature of the disturbance; and then, by all the varied agencies at his command, assumes the rôle of Nature's helper in the promotion of recovery.

There is nothing which the worker in the laboratory can do with his tubes and balances more strictly scientific than the work which engages the practitioner in his daily rounds. For it is the method, not the tools or place or subject of our tasks, which makes them scientific or unscientific. It is just as easy to be unscientific in the laboratory as at the bedside, and in either place it is easy to lose sight of science in the detail of mechanical routine.

But beyond all that which the physician can accomplish as the friend and expert adviser of the sick in whom, first of all, his allegiance centers, as the student of all things which promise help in his fight against disease, as the friendly teacher ever mindful that prevention is better than cure, and as one who toils for Science for her sake alone—beyond all these high offices there is yet another upon whose duties he must now more seriously enter, if he would hope to realize all that which our new outlooks promise. I speak of the duties of citizenship.

Municipal and State health organizations have accomplished much of late in the protection of the people against disease. But the humiliating confession must be made that in many measures of public sanitation in this country we are far behind the requirements of science. This is not, as a rule, because our health officers do not know what to do or how to do. It is not usually because they are indifferent or negligent. But in many cases the pitiful sacrifice of life and the inexpressible suffering and loss which preventable disease involves are due to legislative indifference or folly.

I am aware that there are many exceptions, but I think that I am not mistaken when I say that among the measures vital to the public welfare over which our legislators, State and Federal alike, wrangle and bicker and deal—when these are not treated with indifference and contempt, as not contributory to the profit or to the disgraceful notoriety of the hour—there are none which more often fail of intelligent consideration than those which concern the public health.

But laymen in public office can not be regarded alone at fault if they be not wisely directed; and physicians are not, I think, as keenly alive in this way as they should be to their responsibilities as citizens. They know what ought to be done in the larger public way to render the new knowledge in sanitation and the control of disease available, and yet do not individually or as a guild bring their expert knowledge strongly to bear as the intelligent citizen always can, if he be right and enough in earnest.

There is little doubt that almost any legislative measure which the medical profession unites and persists in urging as essential to the maintenance of the public health can be speedily secured.

I know that there is a general feeling among physicians of the better sort that conspicuous interest in public affairs may be misconstrued and looked upon as in some sort a means of professional advertisement. And one can not choose but appreciate and admire the sensitiveness and high sense of honor of which this sentiment is born. But, after all, there are greater misfortunes in life than being misunderstood, and I think that the fine feeling which leads the physician so often to waive the privileges of social and

public life in the interest of what he conceives to be professional ethics is capable of a richer fruitage yet, in the defiance of misconstruction, when impelled to whatever performance of public duty he can justify to himself.

While the penalties of ignorance in things sanitary and hygienic are growing more severe as our communal life becomes more complex and crowded, there are, as we have seen, a good many ways in which the lessons of modern sanitation can be learned. Some of these lessons may wisely, as I think, be woven into the educational equipment of the young. They may be acquired in later life from books. Many may be assimilated under the kindly offices of the physician. Much is taught by such public measures as health boards may enforce. But, learned these lessons must be sooner or later, and learned they are too often now at the bedside and the grave.

Physicians know well enough that a stringent system of dairy inspection should be at once and widely enforced, and it is really for them more than for any other class of citizens to say how many more object lessons will be necessary like those recently enforced at Montclair, at Waterbury, and at Stamford, before all such caterers shall be compelled to conform to the rules of sanitary decency. The prevention of pollution of water supplies, the compelling of reasonable cleanliness in public vehicles for human transportation by land and by sea, the enforcement of precautions against the spread of disease in public hostelries and places of assembly, the organization of a national health bureau—these are all tasks which must speedily be undertaken, and they may be led to rich accomplishment if the physician will but hold more clearly in his consciousness his primal duty as a citizen.

In all that which I have urged about the more precise physical and, I might almost say, mechanical nature of the professional duties which in the new light the physician is called upon to assume, I have purposely left largely out of sight his more intimate personal relationships to those to whom he ministers. And yet, lest one should fear that in our eager search for light we overlook the man in the machine, I should like to assure the timid that all that which always has and ever will dignify and ennoble his calling, as one who is strong serving the weak, remains unchanged in the physician, and is potent or feeble, not in ratio to his scientific knowledge, but as he is more or less honest, keen of insight, high of purpose, sympathetic; and finds its highest fruition joined to good judgment and self-reliance, and to whatever confidence-winning and hope-inspiring qualities he can command.

It is not easy to estimate accurately the scope and value of contemporary achievement. But as I look over the field of medicine, with all its varying lights and shades, it seems to me that

the things which are most deeply significant in these closing years of the century are not the newly gained skill in diagnosis, not the marvelous strides which surgery has made, beneficent as these may be, not the more exact and purposeful and moderate use of drugs, not the insight which has been gained regarding the complex nature of the nervous system, nor even in the high achievements, too numerous and varied to be even mentioned here, which the new science of bacteriology has made possible.

Beyond all these accomplishments, notable enough though they be for any age, the things which more than all else, it seems to me, will signalize this time, are that we have now definitely freed medicine, in all its borders, from the thralldom of mystery and superstition, have finally and clearly recognized that its problems are the problems of biology, and are to be solved only by such patient research and guarded inference as all science has learned to trust; that the doctor is in command of no mysterious forces, and that the only chance for the full and speedy fruition of our hope in the prevention of disease lies in general education, and in the enlistment of the interests of the people, of whom the medical profession should be the teacher and the guide.

Of course, the shadows here and there will linger on; of course, one and another for some time to come will still invest his calling with the puerile mysteries which were fostered in ignorance, and which should have been put aside with the scarlet cloak and the wig and the ponderous walking stick. Of course, so long as the people are largely ignorant of elementary facts regarding the human frame, quacks will flourish and more or less well-meaning advocates will be found of water, of electricity, of faith, of exorcism, of infinitesimal dosage, and of every sort of named and unnamed folly, as panaceas and as substitutes for science. But, after all, when medicine is once placed where it belongs, close to its sister disciplines, from which it gathers light and in its turn inspires, the shadows are certain soon to fade and the truth to prevail.

You will observe, ladies and gentlemen, that the current of my thought has led again and again to the outlooks which command the field of preventive medicine. This is not only because here the new light shines brightest, and gives clearest glimpses of definite achievement, but also because upon this field success is possible only if we can secure general and earnest co-operation in the spread of the new ideals of cleanliness.

In truth, the exactions of our modern sanitary codes, so far as they affect the performances of the individual and the routine of the household, are neither complex nor burdensome; and a very moderate amount of care, if happily joined to informed intelligence, will suffice, under almost all conditions, for the maintenance of a safe *régime*.

You will, I hope, forgive me for casting the shadow of disease over the festival spirit of this hour. But, after all, our lasting enjoyment is most frequently secured by such physical well-being as these new outlooks in medicine promise to cherish.

And so, gentlemen of the graduating class, at last, to the life-long study of this science which looks out upon so many pathways toward the light, and to the practice of our art, whose aims are ever closely linked to the high realities of life, it is now my privilege, on behalf of our guild, and in the name of the Faculty of this ancient and honored college of medicine, to bid you a cordial welcome.

SUGGESTIBILITY, AUTOMATISM, AND KINDRED PHENOMENA.

By Prof. WILLIAM ROMAINE NEWBOLD.

II. THE PROPERTIES OF MENTAL STATES.—THE CONCEPTION OF THE SUBCONSCIOUS.

THERE is another deduction from the doctrine of parallelism which has been much disputed but which seems to me legitimate. I know that when I glance up from my paper, see a pen, reach out and take it, ether waves which fell upon the retina of my eye produced there chemical changes which irritated the optic nerve; the irritation was transmitted to the visual centers of the brain, thence propagated to the motor centers, and from the motor centers went an impulse which contracted the muscles of my arm. But I am not directly conscious of all this. It seems to me that the conscious state which I call the perception of the pen caused the thought of the movement and the movement itself at almost the same time. Now, if we believe that every conscious state which we know has its physical concomitant of which we know nothing save by inference, I see no reason why we may not, for the time at least, ascribe directly to the mental states the properties which we believe belong in all strictness to their physical bases only. Thus, I think it correct to say that the perception of the pen awakened the thought of taking it and that that in turn produced the movement. Yet in using this form of speech we must guard against certain erroneous inferences which are frequently drawn from it. The first is that the perception of the pen was the *only* cause of the thought of taking it, and so on. We now know that the whole sequence which I have described depends for its existence and development upon the constitution of the total system of processes. This we are apt to forget, when we deal with the mental only, for the law of attention prevents any but a small portion

of those processes obtaining clear recognition in consciousness at any one time: the remainder affect the clearest portion more or less, but exist themselves only dimly in the marginal region to which I am not attending. Again, we must not suppose that in ascribing to the mental state active properties we mean to imply that the mental states could exist or manifest those properties apart from the physical processes which form their basis, or that they can act upon them in any way from outside, as the older psychology supposed. I do not think, as most psychologists do, that this notion is inconsistent with the doctrine of parallelism, but it certainly can not be derived from it, or from the facts upon which it rests. Guarding against these two errors, then, we may justly regard the mental state as an active, dynamic thing, subject to laws and possessed of properties into which it is the business of the psychologist to inquire.

We all know the difference between red as *seen* and red as we *think* it, although the difference is hard to describe. In most persons the sensation red is peculiarly intense and vivid, while the idea is lacking in some indescribable way in both these traits. Now, we have reason to believe that both mental states are of the same general kind, and that the idea is capable of passing into a state indistinguishable from the sensation. Such a transition is known as development. In some persons certain ideas are normally already developed, so to speak, to their maximum degree. A friend of mine tells me that, so far as vividness and intensity go, it makes little difference to him whether his eyes are open or shut—what he sees is about the same in either case. But more commonly the idea must be much heightened before it reaches sensational intensity. Another friend of mine by thinking intently of a friend's appearance can see that friend slowly taking shape, at first as a shadowy outline, then gaining in clearness and solidity until the shadowy outline has become the perfect form of a real person. Now, if we regard the dimmest idea as zero and the clear sensation as the maximum, we may say that any mental state may conceivably run through all the intervening grades, and we have reason to believe that every mental state tends to run through some grades. This I would express by saying that every mental state tends to develop within limits which we can not at present assign. The first property of the mental state, then, is that of development. It is of importance in explaining the phenomena of dreams and hallucinations.

The second group of properties which I shall mention depend upon the transmissibility of the physical impulse. I have already shown in my first paper how mental elements become agglutinated into systems in which any one tends to awaken the others. It is also true of the relation of any one system to another; they tend

to awaken one another. This is what is commonly described as association of ideas. The reverse is also true, although not as well known; many states tend to prevent the appearance of other states. Agreeable states, for example, tend to force out the disagreeable, and *vice versa*. This, then, may be generalized in the statement of the second property of mental states: every mental state tends to produce, or prevent the production of, other states. We may suppose that these phenomena are due to the interplay of systems of activities within the cortex with one another.

But these activities within the cortex which underlie our ordinary life of sensation and thought tend also to discharge downward through the Rolandic region into the motor mechanism, producing contractions of the muscles. Thus the third property of the mental state is the ability to produce or prevent muscular contraction. Not all mental states have this property in the same degree. It is most evidently true of the *feeling* of movement. I once asked a class of sixteen girls to think intently what it would feel like to lift the right hand and touch the left shoulder. After a few minutes had elapsed nine of them confessed having felt a desire to do it. I then dropped the subject and spoke of something else: in a few moments six actually did it. Most persons when concentrating attention upon the thought of what a given movement would feel like, find themselves becoming possessed of a desire to do it, and this desire marks the tendency of the thought to produce the movement. But as we not only feel but also see our movements, we find that the thought of what a movement looks like has also motor value and tends to produce it. This is also true of touches and ideas of touch—indeed, all or nearly all mental states produce some motor changes in the body, but the motor effects of sensations and ideas of sound, taste, and smell are relatively slight.

Again, mental states tend to help or hinder the processes of secretion and nutrition. We all know that the secretions of the salivary glands, of the kidneys, of the mammary, and other glands are readily affected by many mental states, but their effect upon the processes of nutrition is more disputed. It is quite certain that in a general way the impulses sent out by the central nervous system are necessary to the proper nutrition of the body, but it is not as generally accepted that individual mental states can produce definite changes, as, for example, when it is reported that a hypnotized patient, by thinking of a burn, has actually produced the burn. Yet even for this there is good evidence.

One may justly ask how it is, if mental states really have definite consequences, that we fail to note in our mental life the orderly sequence of cause and effect with which we are familiar in the physical world? If there be any truth in the theory above

outlined, this inability to observe it is precisely what one should expect. It is not possible to analyze the total content of consciousness into any definite number of "states." The total state of consciousness at any given moment depends upon the condition and character of a system of physical activities, and its few distinguishable elements are related to some rather than to other elements of that system. But no portion of the system could be what it is if the other portions were not just what they are, and in the succession of the clearer states of consciousness we see not merely the effect of the one clear state upon the next clear state, but the effect of one whole system upon the next whole system; and often the active factor in determining the character of the next clear state is not what was clearest in the preceding, but one of those which were dimly existent in the margin, or even one of those that were subconscious. To determine the true properties of any state it would be necessary to isolate it by breaking up this co-ordination, and that, as I shall show later, we can to some extent do.

Before taking up these more complex forms of disorganization, or, better, disordination, I must make plain the meaning of the word *subconscious*, which I have had occasion once or twice to use.

I am sitting in a chair and reading an interesting story; the clock strikes and I do not hear it. Why? There are only four possible theories. We must suppose that the air vibrations strike the ear drum and are propagated through the ear bones and lymph to the auditory nerve. Then either (1) the physical process is blocked at some point between the terminal filaments of the auditory nerve in the inner ear and its origin in the cortex; or (2) the irritation reaches the cortex, but fails to awaken any cortical process; or (3) it awakens a cortical process which is unaccompanied by any mental state; or (4) it awakens both a cortical process and a mental state. For the first of these alternatives there is no evidence. On the contrary, since I hear the clock strike if I am expecting it, and since all theories require us to regard expectation as dependent upon cortical processes, if any mental phenomena are, we must look to the cortex for the explanation and not to the peripheral machinery. The second alternative is conceivable, but there is no direct evidence for it and there is some against it. It is frequently possible, for example, to awaken by hypnotic suggestion a memory of the event which was not consciously experienced, and, as memory depends upon the traces left by earlier experiences in the cortex, it would seem to follow that there must have been a cortical disturbance. The third alternative is more probable. There is reason for believing that any cortical process must attain a certain degree of intensity before its mental concomitant comes into being at all, and per-

haps the existence of other active processes prevents its attaining that degree of intensity. Again, if we revert to the old soul theory, now almost wholly abandoned by psychologists, but still, I think, worthy of consideration, we may suppose that the cortical process alone can not produce consciousness, but requires the co-operation of some other factor. The *pros* and *cons* in these last two suppositions are too intricate for present discussion, and, indeed, my purpose is, not to prove a theory, but to state the fourth supposition and to analyze some of its logical implications.

The parallel theory would raise the presumption that any cortical process is accompanied by mental phenomena of some kind. We would then assume, in the case under consideration, that the cortical process in the auditory center generated a sound. But how is this to be reconciled to the testimony of consciousness that I heard no sound ?

Well, it may be that I did hear it, but instantly forgot it, so that my present memory of that period contains no trace of it. That this frequently happens there can be no doubt, but there are many curious phenomena which require a further assumption, and that further assumption may be thus stated: The sound may have existed simply as a solitary sound, all alone, not in my consciousness or in the consciousness of any one, but as a bare mental event, related to my consciousness much as a sound in your consciousness is related to mine. It is not an easy conception to grasp, for our mental life always consists of many elements, and it would seem that this multiplicity is essentially involved in our notion of consciousness. Yet occasionally we have experiences which help us in forming the conception of a mental state existing outside a personal consciousness. I remember a trifling operation upon the eye which I once underwent. For a few seconds my consciousness seemed reduced to one element—a flood of frightful pain, which was not in my eye but seemed to pervade my whole being, to the almost complete exclusion of all else. Again, under nitrous oxide, my consciousness seemed reduced to something so rudimentary as to be wholly indescribable. I have heard of many similar experiences.

Without pronouncing upon the relative merits of the last two hypotheses I shall develop some of the logical implications of the latter. A state such as I have described, supposed to exist within my head, so to speak, but outside my consciousness, may be described as subconscious. There are, then, two conceivable ways in which a mental state may vanish from the upper consciousness. The cortical process upon which it depends may die away; it then perishes absolutely; or the cortical process may be dissociated from the system underlying the total consciousness and yet re-

main active, thus giving rise to a subconscious state. This supposition, that a cortical process may exist without coalescing at all with the general system, is a somewhat novel assumption, and it is in my opinion the weakest point of the theory. It would require the further assumption that a cortical system, once coordinated, tends to resist the introduction of a new element into it, and for this there is some introspective evidence.

For consistency's sake the dynamic conceptions which I would apply to mental states in consciousness must be applied also to these mental states existing subconsciously. Subconscious ideas and sensations must be capable of development in intensity and in perfection of finish, so to speak; must be able to awaken associated ideas, to produce bodily movements, to affect secretion and other metabolic processes. It would appear possible that the dissociated processes underlying them may suddenly effect union with the upper system, thus intruding the subconscious state into the upper consciousness. When it does not actually effect union it is conceivable that some of its results, such as its associated ideas or emotional consequents, may appear in the upper consciousness. It is also conceivable that its mere existence may disturb the normal tension of the cortical activities, what has been termed the psychostatic equilibrium of the cortex, and thus affect the upper consciousness. A mental state supposed to be thus growing and working subconsciously has been happily termed by Pierre Janet a mental parasite or neoplasm. For all these inferences, which I have stated as deductions from the hypothesis that there exist mental states dissociated from the normal consciousness, there is a great deal of direct evidence, and it is upon an inductive study of that evidence that the hypothesis is based; but the limitations of space prevent my giving concrete illustrations.

AT a recent meeting of the English Folklore Society, a presentation was made to Mr. G. Laurence Gomme, late president of the society, after which Mr. Gomme spoke of his connection with the society—as honorary secretary, director, president, and now vice-president — since seventeen years ago, when he was one of four who started it in the dining room of the late Mr. Thoms, founder and editor of Notes and Queries. The society had taken its position now, he was sure, as representative of the psychological side of the history of man. With Mr. Brabrook, President of the Anthropological Society, and Prof. Haddon working with them, they hoped as soon as possible to obtain their proper position at the British Association, and, with their scientific standing officially recognized, proceed to accomplish some of the great work he believed they had before them. They were not a *dilettanti* society, playing with antiquities, but they were taking part in unraveling some of the great mysteries of man's nature.

STUDIES OF CHILDHOOD.

XIV.—THE CHILD AS ARTIST.

By JAMES SULLY, M. A., LL. D.,
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ONE of the most interesting, perhaps also one of the most instructive, phases of child-life is the beginnings of art activity. This has been recognized by one of the best-known workers in the field of child-psychology, M. Bernard Perez, who has treated the subject in an interesting monograph.* This department of our subject will, like that of language, be found to have interesting points of contact with the phenomena of primitive race culture.

The art impulse of children lends itself particularly well to observation. No doubt, as we shall see, there are difficulties for the observer here. It may sometimes be a fine point to determine whether a childish action properly falls under the head of genuine art production, though I do not think that this is a serious difficulty. On the other hand, the art impulse, where it exists, manifests itself directly and for the most part in so characteristic an objective form that we are able to study its features with special facility.

In its narrow sense as a specialized instinct prompting its possessor to follow a definite line of production, as drawing of the artistic sort, or simple musical composition, the art impulse is a particularly variable phenomenon of childhood. Some children who afterward take seriously to a branch of art culture, manifest an innate bent by a precocious devotion to this line of activity. Many others, I have reason to believe, have a passing fondness for a particular form of art activity. On the other hand, there are many children who display almost a complete lack, not only of the productive impulse, but of the æsthetic sense of the artist. So uncertain, so sporadic, are these appearances of a rudimentary art among children, that one might be easily led to think that art activity ought not to be reckoned among their common characteristics.

To judge so, however, would be to judge erroneously, by applying grown-up standards. It is commonly recognized that art and play are closely connected. It is probable that the first crude art of the race, or at least certain directions of it, sprang out of playlike activities, and, however this be, the likenesses of the two are indisputable. I shall hope to bring these out in the pres-

* L'Art et la Poésie chez l'Enfant, 1888.

ent study. This being so, we are, I conceive, justified in speaking of art impulses as a common characteristic of childhood.

Although we shall find many interesting points of analogy between crude child-art and primitive race-art, we must not, as pointed out above, expect a perfect parallelism. In some directions, as drawing, concerted dancing, the superior experience, strength, and skill of the adult will reveal themselves, placing child-art at a considerable disadvantage in the comparison. Contrariwise, the intervention of the educator's hand tends seriously to modify the course of development of the child's æsthetic aptitudes. His tastes get acted upon from the first and biased in the direction of adult tastes.

This modifying influence of education shows itself more especially in one particular. There is reason to think that in the development of the race the growth of a feeling for what is beautiful was a concomitant of the growth of the art impulse, the impulse to adorn the person, to collect feathers and other pretty things. Not so in the case of the child. Here we note a certain growth of the liking for pretty things before the spontaneous art impulse has had time to manifest itself. Most children who have a cultivated mother or other guardian acquire a rudimentary appreciation of what their elders think beautiful before they do much in the way of art production. We provide them with toys, pictures, we sing to them, and perhaps we even take them to the theater, and so do our best to inoculate them with our ideas as to what is pretty. Hence the difficulty—probably the chief difficulty—of finding out what the child-mind, left to itself, does prefer. At the same time the early date at which such æsthetic preferences begin to manifest themselves makes it desirable to study them before we go on to consider the active side of child-art. We will try as well as we can to extricate the first manifestations of genuine childish taste.

At the very beginning, before the educational influence has had time to work, we can catch some of the characteristics of this childish quasi-æsthetic feeling. The directions of a child's observation, and of the movements of his grasping arms, tell us pretty clearly what sort of things attract and please him.

In the home scene it is bright objects, such as the fire flame, the lamp, the play of the sunlight on a bit of glass or a gilded frame; out of doors, glistening water, a meadow whitened by daisies, the fresh snow mantle, later the moon and the stars, which seem to impart to the dawning consciousness the first hint of the world's beauty. Luminosity, brightness in its higher intensities, whether the bright rays reach the eye directly or are reflected from a lustrous surface, this makes the first gladness of the eye, as it remains a chief source of the gladness of life.

The feeling for color as such comes distinctly later. The first delight in colored objects is hardly distinguishable from the primordial delight in brightness. This applies pretty manifestly to the brightly illumined, rose-red curtain which Preyer's boy greeted with signs of satisfaction at the age of twenty-three days, and it applies to later manifestations. Thus Preyer found, on experimenting with his boy toward the end of the second year as to his color discrimination, that a decided preference was shown for the bright or luminous colors, red and yellow.* Much the same thing was observed by Miss Shinn in her interesting account of the early development of her niece's color sense.† Thus in the twenty-eighth month she showed a special fondness for the daffodils, the bright tints of which allured another and older maiden, and, alas! to the place whence all brightness was banished. About the same time the child conceived a fondness for a yellow gown of her aunt, strongly objecting to the substitution for it of a brown dress. Among the other colored objects which captivated the eye of this little girl were a patch of white cherry blossom and a red sunset sky. Such observations might easily be multiplied. Whiteness, it is to be noted, comes, as we might expect, with bright partial colors, among the first favorites.‡

At what age a child begins to appreciate the value of color as color, to like blue or red, for its own sake and apart from its brightness, it is hard to say. The experiments of Preyer, Binet, Baldwin, and others, as to the discrimination of color, are hardly conclusive as to special likings, though Baldwin's plan of getting the child to reach out for colors throws a certain light on this point. According to Baldwin, blue is one of the first colors to be singled out; but he does not tell us how the colors he used (which did not, unfortunately, include yellow—the child's favorite according to other observers) were related in point of luminosity.*

No doubt a child of three or four is apt to conceive a special liking for a particular color, which favorite he is wont to appropriate as "my color." A collection of such perfectly spontaneous preferences is a desideratum in the study of the first manifestations of a feeling for color. Care must be taken in observing these selections to eliminate the effects of association, and the unintentional influence of example and authority, as when a child takes to a particular color because it is "mamma's color"—that is, the one she appears to affect in her dress and otherwise.

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* *Op. cit.*, p. 7 and p. 11 f.

† Notes on the Development of a Child, p. 91 ff.

‡ Cf. Perez, L'Art et la Poésie chez l'Enfant, p. 41 ff.

* See Baldwin's two articles on A New Method of Child Study, in Science, April, 1893, and his volume, Mental Development in the Child and the Race.

The values of the several colors probably disclose themselves in close connection with that of color contrast. Many of the likings of a child of three in the matter of flowers, birds, dresses, and so on, are clearly traceable to a growing pleasure in color contrast. Here again we must distinguish between a true chromatic and a merely luminous effect. The dark-blue sky showing itself in a break in the white clouds, one of the colored spectacles which delighted Miss Shinn's niece, may have owed much of its attractiveness to the contrast of light and dark. It would be interesting to experiment with children of three with a view to determine whether and how far chromatic contrast pleases when it stands alone, and is not supported by that of chiaroscuro.

I have reason to believe that children, like the less cultivated adults, prefer juxtapositions of colors which lie far from one another in the color circle, as blue and red or blue and yellow. It is sometimes said that the practice and the history of painting show blue and red to be a more pleasing combination than that of the complementary colors, blue and yellow. It would be well to test children's feeling on this matter. It would be necessary in this inquiry to see that the child did not select for combination a particular color as blue or yellow for its own sake, and independently of its relation to its companion—a point not very easy to determine. Care would have to be taken to eliminate further the influence of authority as operating, not only by instructing the child what combinations are best, but by setting models of combination, in the habitual arrangements of dress and so forth. This, too, would probably prove to be a condition not easy to satisfy.*

I have dwelt at some length on the first germs of color appreciation, because this is the one feature of the child's æsthetic sense which has so far lent itself to definite experimental investigation. It is very different when we turn to the first appreciation of form. That little children have their likings in the matter of form is, I think, indisputable, but they are not those of the cultivated adult. A quite small child will admire the arch of a rainbow and the roundness of a kitten's form, though in these instances the delight in form is far from pure. More clearly marked is the appreciation of pretty, graceful movements, as a kitten's boundings. Perhaps the first waking up to the graces of form takes place in connection with this delight in the forms of motion, a delight which at first is a mixed feeling, involving the interest in all motion as suggestive of life, to which reference has already been made. Do not all of us, indeed, tend to translate our impressions

* The influence of such authority is especially evident in the selection of harmonious shades of color for dress, etc. *Cf.* Miss Shinn, *op. cit.*, p. 95.

of still forms back into these first impressions of the forms of motion?

One noticeable feature in the child's first response to the attractions of form is the preference given to "tiny" things. The liking for small natural forms, birds, insects, shells, and so forth, and the prominence of such epithets as "wee," "tiny" or "teeny," "dear little," in the child's vocabulary alike illustrate this early direction of taste. This feeling again is a mixed one; for the child's interest in very small fragile-looking things has in it an element of caressing tenderness which again contains a touch of fellow-feeling. This is but one illustration of the general rule of æsthetic development in the case of the individual and of the race alike that a pure contemplative delight in the aspect of things only gradually detaches itself from a mixed feeling.

If now we turn to the higher aspects of form, regularity of outline, symmetry, proportion, we encounter a difficulty. Many children acquire while quite young and before any formal education commences a certain feeling for regularity and symmetry. But is this the result of a mere observation of natural or other forms? Here the circumstances of the child become important. He lives among those who insist on these features in the daily activities of the home. In laying the cloth of the dinner table, for example, a child sees the regular division of space enforced as a law. Every time he is dressed, or sees his mother dress, he has an object lesson in symmetrical arrangement. And so these features take on a kind of ethical rightness before they are judged as elements of æsthetic value. As to a sense of proportion between the dimensions or parts of a form, the reflection that this involves a degree of intellectuality above the reach of many an adult might suggest that it is not to be expected from a small child; and this conjecture will be borne out when we come to examine children's first essays in drawing.

These elementary pleasures of light, color, and certain simple aspects of form may be said to be the basis of a crude perception of beauty in natural objects and in the products of human workmanship. A quite small child is capable of acquiring a real admiration for a beautiful lady, in the appreciation of which brightness, color, grace of movement, the splendor of dress, all have their part, while the charm for the eye is often re-enforced by a sweet and winsome quality of voice. Such an admiration is not perfectly æsthetic: awe, an inkling of the social dignity of dress,* perhaps a longing to be embraced by the charmer, may all enter into it; yet a genuine admiration of look for its own sake is the core of the feeling. In other childish admirations, as the girl's

* On the nature of the early feeling for dress, see Perez, L'Art et la Poésie chez l'Enfant.

enthusiastic worship of the newly arrived baby, we see a true æsthetic sentiment mingled with and struggling, so to speak, to extricate itself from such "interested" feelings as sense of personal enrichment by the new possession and of family pride. In the likings for animals, again, which often take what seem to us capricious and quaint directions, we may see rudiments of æsthetic perceptions half hidden under a lively sense of absolute lordship tempered with affection.

Perhaps the nearest approach to a pure æsthetic enjoyment in these first experiences is the love of flowers. The wee round wonders with their mystery of velvety color are well fitted to take captive the young eye. I believe most children who live among flowers and have access to them acquire something of this sentiment, a sentiment of admiration for beautiful things with which a sort of dumb childish sympathy commonly blends. No doubt there are marked differences among children here. There are some who care only, or mainly, for their scent, and the strong sensibilities of the olfactory organ appear to have a good deal to do with early preferences and prejudices in the matter of flowers.* Others again care for them mainly as a means of personal adornment, though I am disposed to think that this partially interested fondness is less common with children than with many adults. It is sometimes said that the love of flowers is, in the main, a characteristic of girls. I think, however, that if one takes children early enough, before a consciousness of sex and of its proprieties has been allowed to develop under education, the difference will be but slight. Little boys of four or thereabouts very often show a very lively sentiment of admiration for these gems of the plant world.

In much of this first crude utterance of the æsthetic sense of the child we have points of contact with the first manifestations of taste in the race. Delight in bright, glistening things, in gay tints, in strong contrasts of color, as well as in certain forms of movement, as that of feathers—the favorite personal adornment—this is known to be characteristic of the savage and gives to his taste in the eyes of civilized man the look of childishness. On the other hand, it is doubtful whether the savage attains to the sentiment of the child for the beauty of flowers. Our civilized surroundings, meadows, and gardens, as well as the constant action of the educative forces of example, soon carry the child beyond the savage in this particular.

How far can children be said to have the germ of a feeling for Nature, or, to use the more comprehensive modern term, cosmic emotion? It is a matter of common observation that they have

* See Perez, L'Art et la Poésie chez l'Enfant, p. 90 f.

not the power to embrace a multitude of things in a single act of contemplation. Hence they have no feeling for landscape as a harmonious complex of picturesquely varied parts. When they are taken to see a "view," their eye, instead of trying to embrace the whole, as a fond parent desires, provokingly pounces on some single feature of interest, and often one of but little æsthetic value. People make a great mistake in taking children to "points of view" under the supposition that they will share in grown people's impressions. Perez relates that some children taken to the Pic du Midi found their chief pleasure in scrambling up the peak and saying that they were on donkeys.* Mere magnitude or vastness of spectacle does not appeal to the child, for a sense of the sublime grows out of a complex imaginative process which is beyond his young powers. So far as immensity affects him at all, as in the case of the sea, it seems to excite a measure of dread in face of the unknown; and this feeling, though having a certain kinship with the emotion of sublimity, is distinct from this last. It has nothing of the joyous consciousness of expansion which enters into the later feeling. It is only to certain limited objects and features of Nature that the child is æsthetically responsive. He knows the loveliness of the gilded spring meadow, the fascination of the sunlit stream, the awful mystery of the wood, and something too, perhaps, of the calming beauty of the broad blue sky. That is to say, he has a number of small rootlets which when they grow together will develop into a feeling for Nature.

Here, too, the analogy between the child and the uncultured Nature-man is evident. The savage has no æsthetic sentiment for Nature as a whole, though he may feel the charm of some of her single features, a stream, a mountain, the star-spangled sky, and may even be affected by some of the awful aspects of her changing physiognomy. Are we not told, indeed, that a true æsthetic appreciation of the picturesque variety of Nature's scenes, of the weird charm of wild places, and of the sublime fascinations of the awful and repellent mountain, are quite late attainments in the history of our race? †

We may now look at the child's attitude toward those objects and processes of human art which from the first form part of his environment and make an educative appeal to his senses; and here we may begin with those simple musical effects which follow up certain impressions derived from the natural world.

It has been pointed out that sounds form a chief source of the

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* *Op. cit.*, p. 103.

† An excellent sketch of the growth of our feeling for the romantic and sublime beauty of mountains is given by Mr. Leslie Stephen in one of the most delightful of his works, The Playground of Europe.

little child-heart's first trepidations. Yet this prolific cause of disquietude, when once the first alarming effect of strangeness has passed, becomes a main source of interest and delight. Some of Nature's sounds, as those of running water and of the wind, early catch the ear, and excite wonder and curiosity. Miss Shinn illustrates fully in the case of her niece how the interest in sounds developed itself in the first years.* This pleasure in listening to sounds and in tracing them to their origin forms a chief pastime of babyhood.

Æsthetic pleasure in sound begins to be differentiated out of this general interest as soon as there arises a comparison of qualities and a development of preferences. Thus the sound of metal (when struck) is preferred to that of wood or stone. A nascent feeling for musical quality thus emerges which probably has its part in many of the first likings for persons; certain pitches, as those of the female voice, and possibly timbres being preferred to others.

Quite as soon, at least, as this feeling for quality of sound or tone, there manifests itself a crude liking for rhythmic sequence. It is commonly recognized that our pleasure in regularly recurring sounds is instinctive, being the result of our whole nervous organization. We can better adapt successive acts of listening when sounds follow at regular intervals, and the movements which sounds evoke can be much better carried out in a regular sequence. The infant shows us this in his well-known liking for well-marked rhythms in tunes which he accompanies with suitable movements of the arms, head, etc.

The first likings for musical composition are based on this instinctive feeling for rhythm. It is the simple tunes, with well-marked, easily recognizable time divisions, which first take the child's fancy, and he knows the quieting and the exciting qualities of different rhythms and times. Where rhythm is less marked, or grows highly complex, the motor responses being confused, the pleasurable interest declines. It is the same with the rhythmic qualities of verses. The jingling rhythms which their souls love are of simple structure, with short feet well marked off, as in the favorite "Jack and Gill."

Coming now to art as representative, we find that a child's æsthetic appreciation waits on the growth of intelligence, on the understanding of artistic representation as contrasted with a direct presentation of reality.

The development of an understanding of visual representation or the imaging of things has already been touched upon. As Perez points out, the first lesson in this branch of knowledge is

* *Op. cit.*, p. 115 ff.

supplied by the reflections of the mirror, which, as we have seen, the infant begins to take for realities, though he soon comes to understand that they are not tangible realities. The looking glass is the best means of elucidating the representative function of the image or "*Bild*" just because it presents this image in close proximity to the reality, and so invites direct comparison with this.

In the case of pictures where this direct comparison is excluded we might expect a less rapid recognition of the representative function. Yet children show very early that picture semblances are understood in the sense that they call forth reactions similar to those called forth by realities. A little boy was observed to talk to pictures at the end of the eighth month. This perhaps hardly amounted to recognition. Pollock says that the significance of pictures "was in a general way understood" by his little girl at the age of thirteen months.* Miss Shinn tells us that her niece, at the age of forty-two weeks, showed the same excitement at the sight of a life-size painting of a cat as at that of real cats.† Ten months is also given me by a lady as the date at which her little boy recognized pictures of animals by naming them "bow-wow," etc., without being prompted.

This early recognition of pictures is certainly remarkable, even when we remember that animals have the germ of it. The stories of recognition by birds of paintings of birds, and by dogs of portraits of persons, have to do with fairly large and finished paintings.‡ A child, however, will "recognize" a small and roughly executed drawing. He seems in this respect to surpass the powers of savages, some of whom, at least, are said to be slow in recognizing pictorial semblances. This power, which includes a delicate observation of form and an acute sense of likeness, is seen most strikingly in the recognition of individual portraits. Miss Shinn's niece in her fourteenth month picked out her father's face in a group of nine, the face being scarcely more than a quarter of an inch in diameter.* I noticed the same fineness of recognition in my own children.

One point in this early observation of pictures is curious enough to call for especial remark. A friend of mine, a psychologist, writes to me that his little girl, aged three and a half, "does not mind whether she looks at a picture the right way up or the wrong; she points out what you ask for, eyes, feet, hands, tail, etc., about equally well whichever way up the picture is, and never asks to have it put right that she may see it better." The

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* Mind, iii, p. 393. † Notes on the Development of a Child, i, p. 71 f.

‡ See Romanes, Animal Intelligence, pp. 311 and 453 ff. The only exception is a photograph which is said to have been "large," p. 453. * *Op. cit.*, i, p. 74.

same thing was noticed in the other children of the family, and the mother tells me that her mother observed it in her children. I have found a further illustration of this indifference to the position of a picture in the two children of another friend of mine. Prof. Petrie tells me that he once watched an Arab boy looking at a picture-book. One, a drawing of horses and chariot, happened to have a different position from the rest, so that the book being held as before, the horses seemed to be going upward; but the boy was not in the least incommoded, and without attempting to turn the book round easily made it out. These facts are curious as illustrating the skill of the young eye in deciphering. They may possibly have a further significance as showing how what we call position—the arrangement of a form in relation to a vertical line—is a comparatively artificial view of which a child as yet takes little if any account. He may be able to concentrate his attention so well on form proper that he is indifferent to the point how the form is placed. Yet this matter is one which well deserves further investigation.*

A further question arises as to whether this "recognition" of pictures by children toward the end of the first year necessarily implies a grasp of the idea of a picture—that is, of a representation or copy of something. The first reactions of a child, smiling, etc., on seeing mirror images and pictures, do not seem to show this, but merely that he is affected much as he would be by the presence of the real object, or, at most, that he recognizes the picture as a kind of thing. The same is, I think, true of the so-called recognition of pictures by animals.

That children do not, at first, seize the pictorial or representative function is seen in the familiar fact that they will touch pictures us they touch shadows and otherwise treat them as if they were tangible realities. Thus Pollock's little girl attempted to smell at the trees in a picture and "pretended" to feed some pictorial dogs.

When the first clear apprehension of the pictorial function is reached it is difficult to say. Miss Shinn thought that her niece "understood the purport of a picture quite well" at the age of forty-five weeks. She draws this conclusion from the fact that at this date the child, in answer to the question, "Where are the flowers?" leaned over and touched the painted flowers on her aunt's gown, and then looked out to the garden with a cry of desire.† But this inference seems to me very risky. All that the child's behavior proves is that she "classed" real and painted

* Prof. Petrie reminds me that a like absence of the perception of position shows itself in the way in which letters are drawn in early Greek and Phœnician writings.

† *Op. cit.*, i, p. 72.

flowers together, while she recognized the superiority of the former as the tangible and probably the odorous ones. The strongest evidence of recognition of pictorial function by children is, I think, their ability to recognize the portrait of an individual. But even this is not quite satisfactory. It is conceivable, at least, that a child may look on a photograph of his father as a kind of "double." The boy C—— took his projected photograph very seriously as a kind of doubling of himself. The story of the dog, a Dandy Dinmont terrier, that trembled and barked at a portrait of his dead mistress,* seems to me to bear this out. It would surely be rather absurd to say that the demonstrations of this animal, whatever they may have meant, prove that he took the portrait to be a memento likeness of his dead mistress.

We are apt to forget how difficult and abstract a conception is that of pictorial representation, how hard it is to look at a thing as pure semblance having no value in itself, but only as standing for something else. A like slowness on the part of the child to grasp a sign, as such, shows itself here as in the case of verbal symbols. Children will, quite late, especially when feeling is aroused and imagination specially active, show a disposition to transform the semblance into the thing. Miss Shinn herself points out that her niece, who seems to have been decidedly quick, was as late as the twenty-fifth month touched with pity by a picture of a lamb caught in a thicket, and tried to lift the painted branch that lay across the lamb. In her thirty-fifth month, again, when looking at a picture of a chamois defending her little one from an eagle, "she asked anxiously if the mamma would drive the eagle away, and presently quite simply and unconsciously placed her little hand edgewise on the picture so as to make a fence between the eagle and the chamois."† Such ready confusion of pictures with realities shows itself in the fourth year and later. A boy nearly five was observed to strike at the figures in a picture and to exclaim, "I can't break them." The Worcester collection of observations illustrates the first confused idea of a picture. "One day F——, a boy of four, called on a friend, Mrs. C——, who had just received a picture, representing a scene in winter, in which people were going to church, some on foot and others in sleighs. F—— was told whither they were going. The next day he came and noticed the picture, and looking at Mrs. C—— and then at the picture, said, 'Why, Mrs. C——, them people haven't got there yet, have they?'"

All this points, I think, to a slow and gradual emergence of the idea of representation or likeness. If a child is capable in moments of intense imagination of confusing his battered doll with

* Romanes, *op. cit.*, p. 453.

† *Op. cit.*, ii, p. 104.

a living reality, he may be expected to act similarly with respect to the fuller likeness of a picture. Vividness of imagination tends in the child as in the savage, and indeed in all of us, to invest a semblance with something of reality. We are able to control the illusory tendency and to keep it within the limits of an æsthetic semi-illusion; not so the child. Is it too fanciful to suppose that the belief of the savage in the occasional visits of the real spirit-god to his idol has for its psychological motive the impulse which prompts the child ever and again to identify his toys and even his pictures with the realities which they represent?

As might be expected, this impulse to confuse representation and represented reality shows itself very distinctly in the first reception of dramatic spectacle. If you dress up as Father Christmas, your child, even though he is told that you are his father, will hardly be able to resist the illusion that your disguise so powerfully induces. Cuvier relates that a boy of ten, on watching a stage scene in which troops were drawn up for action, broke out in loud protestations to the actor who was taking the part of the general, telling him that the artillery was wrongly placed, and so forth.* This reminds one of the story of the sailors who on a visit to a theater happened to see a representation of a mutiny on board ship, and were so excited that they rushed on the stage and took sides with the authorities in quelling the movement.

I believe that this same tendency to take art representations for realities reappears in children's mental attitude toward stories. A story by its narrative form seems to tell of real events, and children, as we all know, are wont to believe tenaciously that their stories are true. I think I have observed a disposition in imaginative children to go beyond this, and to give present actuality to the scenes and events described. And this is little to be wondered at when one remembers that even grown people, familiar with the devices of art imitation, tend now and again to fall into this confusion. Only a few days ago, as I was reading an account by a friend of mine of a perilous passage in an Alpine ascent, accomplished years ago, I suddenly caught myself in the attitude of proposing to shout out to stop him from venturing farther. A vivid imaginative realization of the situation had made it for the moment a present actuality.

Careful observations of the first attitudes of the child-mind toward representative art are greatly needed. We should probably find considerable diversity of behavior. The presence of a true art feeling would be indicated by a special quickness in the apprehension of art semblance as such.

In these first reactions of the young mind to the stimulus of

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* Quoted by Perez, *op. cit.*, p. 216.

art presentation we may study other aspects of the æsthetic aptitude. Very quaint and interesting is the exacting realism of these first appreciations. A child is apt to insist on a perfect detailed reproduction of the familiar reality. And here one may often trace the fine observation of these early years. Listen, for example, to the talk of the little critic before a drawing of a horse or a railway train, and you will be surprised to find how closely and minutely he has studied the forms of things. It is the same with other modes of art representation. Perez gives an amusing instance of a boy, aged four, who when taken to a play was shocked at the anomaly of a chambermaid touching glasses with her master on a *fête* day. "In our home," exclaimed the stickler for regularities, to the great amusement of the neighbors, "we don't let the nurse drink like that." * It is the same with story. Children are liable to be morally hurt if anything is described greatly at variance with the daily custom. Æsthetic rightness is as yet confused with moral rightness or social propriety, which, as we have seen, has its instinctive support in the child's mind in respect for custom.

Careful observation will disclose in these first frankly expressd impressions the special directions of childish taste. The preferences of a boy of four in the matter of picture-books tell us where his special interests lie, what things he finds pretty, and how much of a genuine æsthetic faculty he is likely to develop later on. Here, again, there is ample room for more careful studies directed to the detection of the first manifestations of a pure delight in things as beautiful, as charming at once the senses and the imagination.

The first appearances of that complex interest in life and personality which fills so large a place in our æsthetic pleasures can be best noted in the behavior of the child's mind toward dramatic spectacle and story. The awful ecstatic delight with which a child is apt to greet any moving semblance carrying with it the look of life and action is something which some of us, like Goethe, can recall among our oldest memories. The old-fashioned moving "*Schatten-bilder*," for which the gaudy but rigid pictures of the magic lantern are but a poor substitute, the puppet-show, with what a delicious wonder have these filled the childish heart! And as to the entrancing, enthralling delight of the story—well have Thackeray and others tried to describe this for us.

Of very special interest in these early manifestations of a feeling for art is the appearance of a crude form of the two emotions to which all representations of life and character make appeal—the feeling for the comic and for the tragic side of things. What

* *Op. cit.*, pp. 215, 216.

we may call the adult's fallacy, the tendency to judge children by grown-up standards, frequently shows itself in an expectation that their laughter will follow the directions of our own. I remember having made the mistake of putting those delightful books, Tom Sawyer and Huckleberry Finn, into the hands of a small boy with a considerable sense of fun, and having been humiliated at discovering that there was no response. Children's fun is of a very elemental character. They are mostly tickled, I suspect, by the spectacle of some upsetting of the proprieties, some confusion of the established distinctions of rank. Dress, as we have seen, has an enormous symbolic value for the child's mind, and any confusion here is apt to be specially laughter-provoking. One child between three and four was convulsed at the sight of his baby bib fastened round the neck of his bearded sire. There is, too, a considerable element of rowdiness in children's sense of the comical, as may be seen by the enduring popularity of the spectacle of Punch's successful misdemeanors and bravings of the legal authority.

Since children are apt to take spectacles with an exacting seriousness, it becomes interesting to note how the two moods, realistic stickling for correctness, and rollicking hilarity at the sight of the disorderly, behave in relation one to another. More facts are needed on this point. It is probable that we have here to do in part with a permanent difference of temperament. There are serious, matter-of-fact little minds which are shocked by a kind of spectacle or narrative that would give boundless delight to a more elastic, fun-loving spirit. But discarding these permanent differences of disposition, I think that in general the sense of fun, the delight in the topsy-turviness of things, is apt to develop later than the serious realistic attitude already referred to. Here, too, it is probable that the evolution of the individual follows that of the race: the solemnities of custom and ritual weigh so heavily at first on the savage mind that there is no chance for sprightly Laughter to show himself. However this be, most young children appear to be unable to appreciate true comedy where the incongruous coexists with and takes on one half of its charm from serious surroundings. Their laughter is best called forth by a broadly farcical show in which all serious rules are set at naught.

Of no less interest in this attitude of the child-mind toward the representations by art of human character and action are the first rude manifestations of the feeling for the tragic side of life. A child of four or six is far from realizing the divine necessity which controls our mortal lives. Yet he will display a certain crude feeling for thrilling situation, exciting adventure, and something, too, of a sympathetic interest in the woes of mortals, quadrupeds as well as bipeds. The action, the situation, may

easily grow too painful for an imaginative child disposed to take all representative spectacle as reality; yet the absorbing interest of the action where the sadness is bearable attests the early development of that universal feeling for the sorrowful fatefulness of things which runs through all imaginative writings from the "penny dreadful" upward.

THE FIFTH INTERNATIONAL PRISON CONGRESS.

By SAMUEL J. BARROWS,
SECRETARY TO THE AMERICAN DELEGATION TO THE CONGRESS.

IN no country ought the results of the International Prison Congress, held last summer at Paris, to be received with more interest than in America, for it was an American pioneer in prison reform, the late Dr. E. C. Wines, who took the lead in organizing this series of international prison congresses. The way had been prepared by the formation of local associations in Europe and in this country. Dr. Wines's plan to have a grand international conference was fostered by correspondence with Count Sollohub, of Russia. The American Government backed up the enterprise by appointing Dr. Wines a commissioner to go to Europe a year in advance and secure the co-operation of other governments. The result was the holding of an international congress in London in 1872, and its organization upon a permanent basis, with Dr. Wines as president of the permanent commission. The second congress was held in Stockholm in 1878, the third in Rome in 1885, the fourth in St. Petersburg in 1890, and the fifth in Paris in 1895.

These conferences have steadily grown in interest and influence. The title of the congress hardly gives a full idea of its scope. This international gathering is not merely an assemblage of prison wardens to discuss the subject of prison management, though that alone would be well worth doing; it is as well a gathering of distinguished jurists, legislators, doctors, sociologists, magistrates, the heads of prison administration, and writers and experts on related branches of applied philanthropy. In the Paris congress there were two hundred foreign delegates from twenty-five different nations. In addition to these, the number of French adherents and delegates officially enrolled and personally or formally identified with the congress numbered five hundred and thirty-seven, and included many of the most distinguished names in France. The scope of these congresses has gradually been growing broader. Every subject in any way related to criminology now comes within their field. One of the things which distinguished the Paris congress from its predecessors was the

greater emphasis laid upon preventive work and the establishment of a special department for the discussion of all questions relating to children and minors.

An important feature of these conferences is the large amount of preliminary work that is done in preparation for the quinquennial gathering. The permanent international commission, consisting of eight of the most prominent penologists of Europe, with Dr. Guillaume, of Switzerland, as its efficient secretary, is the organic bridge which unites one congress with the next and gives continuity, unity, and development to the work. This commission has to prepare a programme more than a year in advance. Specialists in all parts of the world are invited to write papers on questions chosen for discussion. The reports for the present congress represented the opinions and experience of two hundred and forty writers, and amounted to twenty-five hundred pages in print. They were all printed in French three months before the opening of the congress, and were sent in advance to the official delegates. Thus every delegate knew beforehand not only the subjects on the programme, but the line of argument which would be advanced and the evidence for and against certain conclusions. Instead of being overloaded by a great mass of papers, the decks were kept clear for discussion. This gave warmth and vivacity to debate. In addition to these reports, the commission secured monographs from many different countries giving facts and statistics in regard to their prison systems. The questions carefully prepared by the commission on which these monographs were framed were uniform throughout, so that the penological student has an opportunity for comparative study not easily secured elsewhere. I am inclined to think that this large amount of preliminary material will prove to be quite as valuable as the proceedings of the congress itself.

Next to the work of the permanent commission, the success of the congress was largely due to the strong official backing and the lavish hospitality of the French Government. The Minister of the Interior, M. Leygues, was the official host. For a year or two in advance M. J. Duflos, the chief director of prison administration in France, aided by his secretaries, had devoted himself to completing arrangements for the congress. This unremitting labor was cordially recognized in the choice of M. Duflos as president. Everything possible was done by the Government to give character and interest to the meeting. The President of the Republic honored the opening occasion by his presence. The Minister of the Interior welcomed it in an admirable address. The College of France was opened for the sessions of the different sections, and the general assembly was held in the amphitheatre of the Sorbonne. Excursions to prison establishments were made,

brilliant receptions were extended by the President of the Republic, the Minister of the Interior, and the city of Paris, and a series of complimentary banquets tested the digestive capacity of the delegates to the utmost.

The session of the congress extended over ten days. It was divided into four sections. The first related to penal legislation, the second to prison administration, the third to preventive means, and the fourth to juvenile offenders. Separate sessions of each section were held every morning. In the afternoon there was a general assembly of the whole congress and reports from the work of each section were heard, discussed, and voted upon.

The first section, dealing with questions of penal legislation, drew together a fine array of legal talent. Nice questions of theory came up for discussion, but they were generally obliged to yield to practical considerations. The great plague of penologists as well as of society is the *recidivist*, or the "repeater," or "rounder," as he is more familiarly called in this country. He is the man or woman who has been in prison half a dozen, or it may be fifty or a hundred, times. The sentiment of the congress was in favor of a gradual accumulation of penalties and of long sentences for professional criminals. The laws of different countries differ in the classification of these *recidivists*. But the congress wisely decided that the dangerous attitude of the criminal toward society was the main thing to consider. It did not present a scheme of penalties, it did not decide in favor of definite or indefinite sentences; it left much to the discretion of the judge, though the feeling was expressed that judges are often more influenced by the gravity of the special act or by the circumstances of the crime than by facts which may clearly reveal the dangerous character of the criminal.

A hot debate, continued through several sessions, occurred on transportation. Though we have long since settled this question in England and America, it is a practical question with France and Russia. In Russia transportation has existed for three hundred years, but it has not tended to reduce crime. None are better aware of this than many prominent Russian jurists and penologists, and an interesting phase of the discussion was the presence of a distinguished representative from Russia, Prof. Ivan Foinitski, Professor of Law in the University of St. Petersburg and general advocate of the Court of Cassation, who led the battle against transportation. Prof. Foinitski has written an important work on the subject, which has just been made available in French through a translation by M. G. Bonet-Maury. In this volume, after an elaborate description of transportation in England and Russia, he shows that it has nothing but negative results to offer, and rejects entirely the arguments advanced for it. In France

transportation was adopted about forty years ago, and still exists in the penal colonies of Guiana and New Caledonia. The French system has strong advocates, and found one of its warmest defenders in Prof. Leveillé, of the faculty of law of Paris.

The subject of compensation or restitution for injured parties has been commended at previous congresses. It has long been felt that modern laws do not sufficiently indemnify the victim of crime. The difficulty is to show practically how this may be done. It might be possible to apply a portion of the prisoner's earnings to the relief of his victim, but the amount thus gained would not be large. It is suggested that by combining conditional liberation with the idea of reparation much more might be effected. In some respects the laws are harder upon the victim than upon the offender. Thus in France, while in a case submitted to a jury costs are not assessed upon the complainant if the complaint is sustained, in all other cases the complainant is obliged to defray the costs of the process whether for or against him. The congress passed resolutions looking for a change in such laws, and decided to take into serious consideration at its next session, in 1900, various propositions for the relief of the injured party.

Imprisonment is not the only means of checking crime; and no question more important came before the congress than the subject of probation for first offenders. On this subject America has some experience to offer, and Mr. Charlton T. Lewis, of New York, and the writer had the honor of presenting to the congress brief expositions of the method and results of the probation system in Massachusetts. That State now has a probation officer attached to each criminal court in every city and county, and there are seven in the city of Boston. In the year 1893–'94 47,249 cases passed under their examination before going into court, and 5,317 were placed on probation. This probation system deserves wider attention. One of its most important features is not only the examination by the officer before trial, which induces the judge to place the accused on probation, but the visitation and surveillance exercised by the officers during the probation period.

In the whole matter of prison administration the congress had the advantage of the presence of a large number of practical and experienced prison directors. Politicians on this side of the water are fond of tampering with the subject of prison labor. But labor in prison was recognized by this, as indeed by every prison congress, as an essential element in discipline and reformation. To deprive prisoners of labor is simply inhuman, and in the end results in transferring the criminal from a prison to an insane asylum. The need of special prisons for women with women directors was affirmed, and while the right of a prisoner to wage

was not conceded, it was agreed that it was for the interest of the state to give him gratuities. As a matter of fact, the system of allowing the prisoner a portion of his earnings obtains all over the Continent. Half of the amount thus earned may be expended by him, under supervision of a director, or may be applied to the relief of his family. The other half is retained until the time of his discharge.

In Europe the cellular or separate system of imprisonment prevails much more extensively than in this country. Indeed, our only example of such a prison is that of the Eastern Penitentiary of Philadelphia. The reformatory system as developed in this country and illustrated by such institutions as those of Elmira, Concord, and Pontiac was ably presented to the congress by General R. Brinkerhoff, President of the National Prison Association of the United States, and by Mr. R. W. McClaughry, who, having had experience as chief of police of Chicago and as the head of several prison institutions, is one of the highest authorities in this country on the treatment of criminals.

Discussion on the treatment of the criminally insane brought out different points of usage in different countries. A large amount of information was gathered. Some questions were formulated for the next congress, among them the following: What rule should be adopted to insure the possibility of a permanent medical control over the mental state of prisoners? How should asylums or quarters for insane criminals be organized so that the necessities for treatment may be combined with the idea of repression? In the case of irresponsible delinquents and those who commit crimes under temporary aberration, the congress expressed the view that special asylums or quarters should be provided for them, that they should be committed by judicial authority, and only released upon the concurrence of a threefold authority—namely, the authority of the court, that of the administration of the institution, and of its medical council.

Under the head of "Preventive Means" were considered those influences not only which would keep men out of prison, but those which would tend to prevent them from becoming habitual criminals. The whole treatment of the subject of discharged convicts received serious consideration. It is somewhat surprising that Europe is far better organized than the United States for the care of the discharged convict. There are but four or five really active societies of this kind in the United States. There are ninety in England alone, and fifty in France. They abound in Holland and Denmark, and are being developed in Germany, Austria, Russia, and Italy. In Spain, work of this kind scarcely exists; in Switzerland, it is seen at its highest degree of efficiency. In a country but half the size of the State of

Ohio there are fourteen societies for discharged convicts, and some of these societies are organized with committees in every district of the canton in which they are established. But the most valuable and distinctive feature of the Swiss system is the appointment of a person, called a patron, who makes the acquaintance of a prisoner before he is discharged, and who becomes his guardian after his liberation. This system of personal and friendly supervision is infinitely better than almsgiving, and its value has been shown in the great reduction of recommitments to prison in the districts where it is best established. These foreign societies are supported by government aid as well as by private subscriptions, and a part of their work consists in guarding the earnings which the prisoner has accumulated during his detention against wasteful expenditure.

The value of prison libraries was recognized, and the desirability of a weekly publication in prisons under the special control of the administration. In this country good examples of such publications are furnished by The Summary, of Elmira, N. Y., and Our Paper, of Concord, Mass.

Alcoholism was regarded as a growing danger, especially with reference to its influence on criminology. Reports from inebriate asylums in Europe show that habitual drunkenness may be treated with success if the victim can be retained sufficiently long. With a view of reducing intemperance in Russia, the Government has already begun to acquire the entire monopoly of the liquor traffic. Among preventive measures, the congress commended the regulation and the limitation of saloons, the multiplication of temperance *cafés*, the establishment of inebriate asylums, and the association of public authority with private agitation in the temperance cause.

No discussions were more earnest than those which related to juvenile offenders. The presence of women of experience in this and every other section of the congress was warmly encouraged, and they were gallantly welcomed by M. Pols, vice-president of the commission, who frankly said that the solution of these questions could not advance without the co-operation of women. The multiplied aspects of vagabondage and mendicity, the subject of prostitution and the measures to be taken to break up the systematic trade carried on between various countries through the decoy of young girls, the establishment and regulation of houses of correction, the need of appropriate physical as well as mental education, the relation of parental responsibility and the question of farm school and agricultural colonies, the placing out of children in families, and the supervision of children thus placed were discussed as important phases of child-saving work.

It is not a criticism of the congress of 1895 to say that it opened more questions than it decided. Penology, like every other science, must advance by interrogations even more than by affirmations. With the growth of knowledge problems multiply and become more complex. But we are better prepared to grapple with difficult conditions when we know what they are; and one of the most hopeful elements in dealing with the subject of criminology in all its varied and elusive relations is the existence of an organized international corps of men and women who approach the matter in a calm, judicial, scientific, and humane spirit.

BOTH SIDES OF PROFIT-SHARING.

By FREDERIC G. MATHER.

THERE seems to be no immediate prospect of ending the contest between capital and labor. No matter how strikes or lockouts are settled, they leave a bad feeling behind them that will be shown as soon as another opportunity offers. Mutual distrust and jealousy mark the situation to-day as they have marked it for many years past. The capitalist votes one way, and the employees vote another, so that they may not oblige him. In every dealing between the two sides the opposition is carried so far that a good understanding seems more remote than ever. Nor does there appear any hope for improvement till each party is ready to make concessions.

The old system of apprenticeship drew more closely the bonds of common interest between the employer and the employee, and with benefit to both. It was comparatively easy for apprentices to become employers. But labor-saving machinery has made the workman an attendant upon the machine, and it has destroyed that sympathy between him and his employer which was the strength of the apprentice system. The blame for this rests upon neither side exclusively. The system may have been too slow to satisfy modern conditions, but the departure of it has made the situation worse. No longer do workmen, as a rule, educate themselves in schools of technology and by the reading of books. There is no inducement for doing better things while the doctrine holds that one man's work is as good as another's, and while labor organizations restrict the number of youth who shall learn trades, thereby keeping all on the same level and giving none an incentive to rise.

The establishment of boards of arbitration will not meet the present difficulties. Those who adopt the idea, on the strength of declarations made by both sides, of a desire for a reasonable settle-

ment of disputes should reflect that the same definition is not given to the words "reasonable" and "equitable" by either the labor unions or the employers. Each side has its own definition, and until that is known everything is uncertain. Neither side would consent to have a course dictated by any form of official authority, because everybody knows his own business best. No rational man can believe that any large business can be conducted upon lines laid down by outsiders. Much less can he believe that workmen can be forced to respect the decision of an official board when they do not cordially accept that decision.

The fatal defect in treating the labor problem thus far has been the stress laid upon the change of method, when the needful thing is a change of spirit in both parties to the controversy. The friction has a moral cause that is common to both, and it will continue as long as mere gain is held to be the measure of success. It can not be stopped by any mechanical contrivance of system or method. But when success and use are made synonymous, the friction will yield, because the moral and sympathetic forces have begun to work upon a higher plane. This idea was well expressed about fifty years ago in Boston, when the Rev. Dr. Channing delivered a course of lectures on The Elevation of the Working Classes. In one of them he said: "There is but one elevation for a laborer and for all other men. There are not different kinds of dignity for different orders of men, but one and the same for all. The only elevation of a human being consists in the exercise, growth, and energy of the higher principles and powers of his soul. A bird may be shot upward to the skies by a foreign power; but it rises, in the true sense of the word, only when it spreads its own wings and soars by its own living power. So a man may be thrust upward into a conspicuous place by outward accidents, but he rises only in so far as he exerts himself and expands his best faculties; and he ascends by a free effort to a nobler region of thought and action. Such is the elevation I desire for the laborer, and I desire no other."

There seems to be but one practicable method of reaching this elevation, and even that method is practicable only within certain limits. Profit-sharing or wage-sharing may be that method, if the respective shares due to employer and employee can be adjusted equitably. The method has been tried with success in several branches of productive industry.

In 1844 the Paris and Orleans Railway Company adopted the principle. Between 1844 and 1882 about twelve million dollars were distributed as profit dividends among the employees, while the wages paid to them were equal to those paid by roads that gave their employees no share in the profits; and, at the same time, the dividends to the stockholders were as large as they would

have been had there been no profit-sharing. Students of political economy are familiar with the Ateliers Socialistes of Paris. Many of the smaller enterprises in the same city have also applied the system of profit-sharing with remarkable success, one of the most conspicuous being the Atelier de Broderies of M. Nayrolles. In this establishment the system is carried out among a *personnel* composed exclusively of women, and with astonishing results both with the quality of the work and the increased wages of the workers.

A notable scheme, recently tried in England, is that of the South Metropolitan Gas Company of London, as a sequence to the successful campaign of the dock laborers. The company proposes to pay an annual bonus, based upon a sliding scale and regulated by the price paid for gas by the public. At the present price the bonus would amount to five per cent on the wages of the twelve months ending on the 30th of June. In addition, to give the system a start, and in order that the workmen shall derive a substantial benefit at once, the bonuses are to be calculated for three years back. The men who have been in the regular employ of the company for the past three years will thus have sums varying from twenty-five to thirty dollars placed to their credit at once. It is stated that if all the workmen take advantage of this offer it will cost the company fully sixty thousand dollars a year, all of which is a clear gain to the men over and above their regular rate of pay. Another late example comes from a factory of wood pulp in Norway, where nearly sixty men are employed. The gross profit of the first year amounted to about seventy thousand dollars, from which three thousand dollars was taken out for interest on the capital, and fifteen thousand dollars for working expenses. The remainder has been distributed to the men, giving them about one hundred and fifty dollars each. Nearly all of them have used the money in making payments on houses for themselves, thus leading to contentment and industry.

Within the past four years a prominent firm of clothiers in New York city has declared dividends of three and five per cent on the wages of its employees; and a leading merchant of Philadelphia divided $109,439 and $104,345 among his employees in two successive years. After several experiments in other lines, a publishing house in Chicago adopted profit-sharing about fifteen years ago. The house has increased its capital stock more than once; and many of its men, who were ordinary workmen under the old system, now own their homes and are worth from five thousand to fifty thousand dollars each. In another establishment, also in Chicago, those who had been in the employ of the company for one year or more were informed that if the amount of their sales for six months should exceed the total for the same period of time

in the previous year, they would be allowed a commission on the excess. The commission averaged two and a half per cent. The employees at once increased their efforts to sell; and when the first distribution was made, last July, it was found that several of the girls had drawn nearly one hundred dollars as their share of the profits for six months.

The Bodwell Granite Quarry, in Maine, adopted the profit-sharing system in the year 1885. As a result, the output of the works has increased, and the employees are sober, contented, and industrious. The arrangement is this: Ten per cent of the profits is laid aside every year. The remaining profits are divided equally between the employer, the men, and a contingent fund. When the latter reaches more than one per cent of the loss in any one year, the surplus of the fund is divided equally between the employers and the men. It is not probable that there could be losses larger than the contingent fund, unless the business were very poorly managed, or unless a financial crisis came over the whole country.

The largest manufacturer of felt shoes in the United States, after experiment with several forms of profit-sharing, has recently formulated rules and regulations for the just distribution of the net earnings among his employees. There are to be three classes for this distribution: first, pension; second, life insurance; third, endowment. The share of the net earnings to be set aside every year shall be calculated upon the positive results of the records of the actual work done by the employees. Against this distribution account the amounts paid for life insurance, under the provisions of the insurance law, and the amount necessary to maintain the pension fund are to be considered fixed charges. As soon as the workman is made a partner in the business, so that a loss to his employer is a loss to him, it will make him more careful of his time. He will see that his fellow-workman performs his duty, and that there is no waste by any one. Such an arrangement is profitable to the employer in the end, because every man in his employ will have some incentive to work. The employer thus guarantees extra pay to the employed.

But can any one guarantee to the employer that every year will be a profitable one? And if there are losses, who shall make them up? Shall the employers make them up by themselves, or shall the men, having once been taken into a partnership upon the profits, still continue that partnership by making up their share of the losses? There are many employed men who are the owners, or the partial owners, of their homes. They would gladly enter into an arrangement for the division of the profits, but they would hesitate to mortgage their homes as security for their proportion of the losses in a bad year. Other employees could offer

no security whatever in such a case; therefore, the losses must come upon the employers in the end. It is this fact, more than any other, that hurts the prospects of profit-sharing. Such an arrangement can not be in the nature of a true partnership, because, as noted above, there is a partnership so far as the gains are concerned, but the partnership ceases when there are losses. Hence, as at present tried, the system of profit-sharing is really a gratuity on the part of the employers, most of them having taken the ground that they must average their good years with their poor years in order to keep their men employed uniformly.

The machinery of profit-sharing is not complete without some provision for a contingent fund to tide the employer over his bad years; and even then it is a question whether the profits should not be disposed of on a basis of piecework instead of time. In a bad year the capitalist should accept a smaller percentage on his investment; and the workman, a smaller compensation for his labor. It may be hard for the employer to send his children to cheaper schools, but it is no harder than it is for the employee to go without butter and other necessaries of life.

Even with the instances of profit-sharing that have been tried there has been little gain in bringing about a true sympathy between the employers and their men. Without such sympathy, it is impossible for capital and labor properly to understand each other, or to work in harmony. A careful study of the instances in which profit-sharing has been a success shows that the employers who have succeeded were the small employers of a generation ago, before the advent of the great corporations. There could be no greater enemy to the cause of the workingmen than the prevailing idea of to-day to combine everything in the shape of trusts. Edward Bellamy and other writers carry more truth in their predictions than will be admitted by those who have made no study of the facts. Some day there may be a revulsion of feeling against such combinations that may lead to the more simple and direct methods of employment in practice two generations ago, when strikes were almost unknown. The present tendency toward trusts is wholly away from any form of profit-sharing, and this is one of the worst signs of the times.

We are led irresistibly to the conclusion that neither profit-sharing nor any other device will improve the present situation, so long as there is a lack of sympathy in either side toward the other. The employers and the holders of great wealth should regard themselves not as mere irresponsible giants of finance, but as sacredly responsible to society for the large interests that have been intrusted to them. The too frequent want of such a broad idea of his functions has led the public to believe that the capitalist is a man who absorbs all the toil of the laboring man, leav-

ing to the latter a very uncertain subsistence. Nor does the capitalist have credit for the fact that, without him, labor would not be so productive, and for the further fact that his share is taken from a product that was created largely through his direction, his enterprise, and his resources. It makes a vast difference whether an army has a skillful general at the head, or only an ordinary leader.

On the other hand, the employee should remember that, as things are now constituted, there is no employment without the use of capital. He must not consider the capitalist as his enemy, but rather as his friend. Nor should he close his organizations against all who do not work with their hands. His own day of labor measures eight or ten hours. There are other laborers in the field to whom a day's work means from twelve to sixteen hours. They are none the less laborers because they work with their heads, and it is a narrow definition of the "workingman" that rules them out.

When De Tocqueville studied the institutions of the United States, in 1835, he gave a broad view of labor as he wrote, "Every honest occupation in the United States is honorable." The same view must be taken by both the capitalist and the workingman before true sympathy between them can be assured. Until that day comes, neither profit-sharing nor any other form of effort will be able to bridge the chasm.

SKETCH OF EBENEZER EMMONS.

AUTHORITIES differ as to the year in which EBENEZER EMMONS was born. The first General Catalogue of Williams College, published in 1880, puts "*æt.* 65," after the year of his death. In Durfee's Williams Biographical Annals the year of his birth is given as 1799, while, according to Prof. Jules Marcou, in Science, Prof. Emmons always stated to his children that he was born in 1800. His sister has informed the writer that 1799 is the correct year. The month and day were May 16th, and the place was Middlefield, Mass. He was an only son, but had two sisters older and two younger than he. Prof. Emmons's father, who also bore the name of Ebenezer, was a farmer. His mother's maiden name was Mary Mack. The Rev. Dr. Nathaniel Emmons, who was quite a noted preacher in his day, was an uncle. The first ancestor in America of this branch of the family came from England, and settled at East Haddam on the Connecticut River. A brother who came with him settled in Boston.

Young Eben's interest in Nature appeared at an early age. The doors in his room were covered with bugs and butterflies

pinned on when he was a small boy. His mother often used to say: "Eb, why do you always have your pockets filled with stones? I have to mend them every week." His birthplace and the adjoining town of Chester were noted for rare minerals. When he came home for a vacation from school or college he generally brought some fellow-student with him. He and his friend would set off for the mineral localities and be gone all day, coming back tired and hungry, but were always ready to go again the next morning.

He was fitted for college under the instruction of the Rev. Moses Halleck, of Plainfield, Mass., a well-known educator of his time, and was graduated from Williams College in due course. Prof. Marcou gives 1820 as the year of his graduation, but the General Catalogue has him in the class of 1818, which seems to be conclusive. As a college student his interest in the sciences was quickened by the instruction of Prof. Amos Eaton and Prof. Chester Dewey, and he subsequently had a large share in introducing the study of these subjects among the young men of the country. After completing his college course Mr. Emmons continued his favorite studies at the Rensselaer School, graduating there with the class of 1826. In the same year he published his Manual of Mineralogy and Geology for the use of the students of that institution. He also studied medicine at the Berkshire Medical School, and established himself as a practicing physician in Chester, Mass.

In 1818, at the age of nineteen, Mr. Emmons married Miss Maria Cone, of Williamstown, and at the age of thirty-seven became a grandfather by the birth of a son to his eldest daughter.

In 1828 Dr. Emmons removed to Williamstown, where he continued to practice medicine, and in the same year was appointed lecturer on chemistry in Williams College. A cabinet of mineralogical and geological specimens which he began to collect here was presented by him to the college after it had received the valuable accretions of twenty years. He resided in Williamstown until 1838, becoming the most eminent practitioner in Berkshire County. In 1830 he was appointed junior professor in the Rensselaer School and held the position till 1839. He was also a lecturer in the Medical School of Castleton in the days of its renown. His chair in Williams College was enlarged in 1833 * to a professorship of Natural History, which he held till 1859, when the department was divided, he retaining the mineralogy and geology till his death.

Having been appointed upon the Geological Survey of New

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* The History of Williams College, another book by the Rev. Calvin Durfee, D. D., above quoted, gives 1848 as the year of his election to the professorship of Natural History.

York in 1836 and Professor of Chemistry in the Albany Medical College in 1838, Dr. Emmons removed in the latter year to Albany. He was afterward transferred to the professorship of Obstetrics, and remained on the faculty of the Medical College till 1852. During this period he used to go to Williamstown each year to deliver the course of lectures belonging to his professorship there. His position on the New York survey enabled him to make the valuable present of a suite of the minerals of that State to his *alma mater* in 1842. One of his Williams College students—now himself a venerable though young-hearted professor—well remembers the strong face and beetling brows of Dr. Emmons, and his manner of giving instruction. His disposition was kindly. Being a non-resident, not much was seen of him by the students; he would appear at the lecture room, give his lecture, and disappear. There was not much of the pedagogue about him. Students who had a special liking and capacity for his subject profited much from his instruction; but his enthusiasm in telling the wonders of the rocks carried him along at a rate which left the indifferent student far behind. If only a fraction of his class appeared at the lecture, or if he projected a question at Brown and a response came from Jones or Robertson, he seemed not to notice the difference. Williamstown is in the heart of the Berkshire Hills. One of the summits of East Mountain, a neighboring eminence, is the only place in that region where gneiss crops out, and here Prof. Emmons used to bring his students to display to them as best he could the relations of his much-disputed Taconic System to the other and then better known geological formations. Very likely only a couple of the class would reach the summit with him, yet he would discourse just as earnestly to these as to the whole party that set out with him. This height, says Prof. Arthur L. Perry, in his Origins in Williamstown, "has been justly designated Mount Emmons, by one who was once a pupil and later a colleague and always an admirer of the distinguished Professor of Natural History in the college, Ebenezer Emmons."

It is related of Prof. Emmons, as illustrating his enthusiasm, that once when on a journey with President Hopkins, of Williams, and the president's brother, he asked his friends to turn aside with him to visit a certain cave. They consented to the delay, although the brother was on his way to be married, and waited just within the entrance of the cavern while Emmons penetrated to its inmost depths. After a time they heard the excited cry, "I've got it! I've got it!" and out rushed the geologist, bearing triumphantly a muddy fragment of rock. He had secured a piece of evidence in support of his Taconic System.

In 1836 a law was passed providing for a geological survey of

the State of New York, and in the organization of the staff for carrying on that work Dr. Emmons was appointed by Governor Marcy to the charge of the second district, which included the northeastern counties of the State. This district was chosen by Dr. Emmons as a field more especially interesting to him on account of its mineral localities and minerals, and giving him a field more congenial to his tastes and experience. He made the public acquainted with the Adirondack region and named its principal mountains. In 1837 he named, described, and classified the celebrated Potsdam sandstone. Among the other rocks and divisions to which he gave a name or a place in geology are the Chazy limestone, black marble of Isle la Motte, Lorrain shales, Champlain group, Ontario group, Helderberg series, and Erie group. During the progress of this survey, also, he made the important discovery that is most closely associated with his name. In 1842 he pointed out a great system of stratified rocks under the Potsdam, which he called the Taconic System. This announcement brought upon him a storm of contradiction and ridicule, and for a time he was scientifically ostracized. Subsequent discoveries by the Canada Survey, and by Barrande, in Bohemia, however, as well as the investigations of later eminent geologists, have completely sustained him. In propounding the term Taconic* System Prof. Emmons was following the instruction and views of his teacher, Prof. Amos Eaton, who promulgated his opinions regarding the age of these rocks in his lectures at Williams College from 1817 onward; and subsequently in his lectures at the Rensselaer School to the end of his life, although never having published any satisfactory account of the relations of these rocks to the formations above or below them.

Two years later Dr. Emmons described the primordial fauna, thus preceding the celebrated discoveries of Barrande, who recognized the priority of Emmons in the following courteous language:

"In comparing these dates it is clear that Dr. Emmons was the first to announce the existence of a fauna anterior to that which had been established in the Silurian System as characterizing the Lower Silurian Division, and which I have named the Second Fauna. It is, then, just to recognize the priority, and I think it all the more fitting to state it at this time, that it has not hitherto been claimed."

Prof. Emmons's Report on the Second District of the New York Geological Survey was published in 1842. In the autumn of that year his colleagues presented his name to Governor Seward as a proper person to act as custodian of the collections of the geologi-

* From the Taghkanic Mountains.

cal survey, then arranged, and in progress of arrangement, in the old State Hall on State Street, which building had been assigned for that purpose by the Legislature of 1840. He was appointed to this position by Governor Seward and assumed charge of the collections in the latter part of 1842. On the same occasion on which this recommendation was made it was also recommended by the staff that the work in agriculture and paleontology which had been left unfinished should be assigned to Dr. Emmons and Prof. Hall.

In the spring of 1843 Governor Bouck directed Dr. Emmons to investigate the agricultural resources of the State; and the paleontology was placed under the charge of Prof. Hall, while Dr. Emmons still retained his position as custodian of the collections of the survey until 1845. The five volumes of his report on the Agriculture of New York appeared in 1846, 1849, 1851, and 1854. The first was devoted to a "topographical sketch of the State, climate and temperature, agricultural geology, the Taconic System, and the soils of New York"; the second to analyses of grains and other vegetable products; the third and fourth, one consisting of text, the other of plates, to cultivated fruits; and the fifth to injurious insects. This fifth volume has been severely criticised, but it should be remembered that the writer to whom its preparation was intrusted, not being versed in entomology, could only compile from the best sources at his command, at a time when the science was in its infancy, and comparatively little was known of the insects of the State. The many illustrations, which are well colored in the larger portion of the edition, were mainly drawn from Nature, and in some of the orders, as in *Coleoptera* and *Hemiptera*, have a degree of excellence which is rarely surpassed even at the present day.

About the time the third volume came from the press he was appointed State Geologist of North Carolina. In his new field he made further important contributions to the advance of American geology. In the coal measures of the Deep and Dan Rivers he discovered a grand Triassic flora, and a fauna that included among many ancient vertebrates the *Dromatherium sylvestre*, the oldest mammal yet found anywhere in the world. His description of the new red sandstone flora of North Carolina proved so valuable that twenty years after his death the United States Geological Survey reproduced all the plates and descriptions given by him in the sixth part of his American Geology. Three volumes of North Carolina reports were published by him. One on the Geology of the Midland Counties was issued in 1856; a volume devoted to the Agriculture of the Eastern Counties, with descriptions of the fossils of the marl beds, in 1858; and a second part of his report on the agriculture of the State, "containing a

statement of the principles of the science upon which the practices of agriculture as an art are founded," appeared in 1860. The civil war interrupted his labors. The anxieties and separation from friends occasioned by it probably hastened his death, which took place at his residence in Brunswick County, N. C., October 1, 1863. His wife, a son, and two daughters survived him.

Besides the works already mentioned, Prof. Emmons published an account of the Taconic System (Albany, 1844). Having been commissioned by Governor Edward Everett to report upon the Zoölogy of Massachusetts, he prepared a volume, devoted to the quadrupeds, which was printed at Cambridge in 1840. His American Geology, which appeared in 1855, was supplemented by a Manual of Geology in 1859.

A clear-sighted and energetic worker, Dr. Emmons was a living force for the advancement of his chosen science. The Rev. Mark Hopkins, President of Williams College from 1836 to 1872, said of him: "Emmons was a man of remarkable power and great accuracy of observation. He seemed to have an intuitive perception of the differences in natural objects. He possessed an intense enthusiasm in his work, but in his manner was remarkably quiet. I have never seen the two things combined to the same extent. His perseverance knew no limit. It ought to be added that, in connection with his science, he was deeply religious. Williams College is greatly indebted to him for its collections in natural history."

SEVERAL instances of the European survival of practices that probably originated in cannibalism were cited in a discussion on that subject at the meeting of the British Association. Mr. Elworthy said that in one part of France the last of the harvest corn is baked into a loaf shaped like a human figure. This is supposed to represent the spirit of the corn—the spirit of vegetation, reproduction, fertility—and is broken up, distributed among the villagers, and eaten. Mr. E. S. Hartland said that not long ago, in upper Bavaria, when a man died and had been laid out, a cake was made of ordinary flour. The corpse was placed before the fire, and this cake, called the corpse cake, was put upon his breast to rise. The dough, in rising, was believed to absorb all the virtues of the deceased, and the cake was afterward eaten by his nearest relatives. In the Balkan Peninsula an edible image of the dead was carried in the funeral procession. When the body was buried the mourners ate this image above the grave, saying, "God rest him!" In Wales the function of the "sin-eater" has only ceased within the memory of men still living. It was the custom for the nearest relative, usually a woman, to hand across the bier, or place upon the breast of the corpse, bread, cheese, and beer, which were eaten by the sin-eater, who pronounced everlasting rest to the departed. It was believed that the sin-eater thus appropriated to himself all the sins which the deceased had committed.

PROFESSIONAL INSTITUTIONS.

IX.—ARCHITECT.

By HERBERT SPENCER.

BUILDING of the kind dignified by the name architecture, can not exist during early stages of social development. Before the production of such building there must be an advance in mechanical arts greater than savages of low type have made—greater than we find among the slightly civilized.

It is true that constructions of unhewn stones arranged upon the surface into some order, as well as rude underground stone chambers, have been left by prehistoric peoples, and that incipient architecture is exhibited in them. If we extend the conception to take in these, however, we may remark as significant, that the art was first used either for preservation of the dead or as ancillary to ceremonies in honor of the apotheosized dead. In either case the implication is that architecture in these simple beginnings fulfilled the ideas of the primitive medicine-men or priests. Some director there must have been; and we can scarcely help concluding that he was at once the specially skillful man and the man who was supposed to be in communication with the departed spirits to be honored.

But now, saying nothing more of this vague evidence, let us pass to evidence furnished by those semi-civilized and civilized peoples who have left remains and records.

We are at once met by the broad fact, parallel to the fact implied above, that the earliest architecture bequeathed by ancient nations was an outcome of ancestor-worship. Its first phases were exhibited in either tombs or temples, which, as we have long ago seen, are the less developed and more developed forms of the same thing. Hence, as being both appliances for worship, now simple and now elaborate, both came under the control of the priesthood; and the inference to be drawn is that the first architects were priests.

An illustration which may be put first is yielded by Ancient India. Says Manning:—"Architecture was treated as a sacred science by learned Hindus." Again we read in Hunter—

"Indian architecture, although also ranked as an *upa-veda* or supplementary part of inspired learning, derived its development from Buddhist rather than from Bráhmanical impulses."

In Tennent's *Ceylon* there are passages variously exhibiting the relations between architecture and religion and its ministers. By many peoples the cave was made the primitive tomb-temple; and

in the East it became in some cases largely developed. A stage of the development in Ceylon is described as follows:—

"In the *Rajavali* Devenipiatissa is said to have 'caused caverns to be cut in the solid rock at the sacred place of Mihintala'; and these are the earliest residences for the higher orders of the priesthood in Ceylon, of which a record has been preserved."

"The temples of Buddha were at first as unpretending as the residences of the priesthood. No mention is made of them during the infancy of Buddhism in Ceylon, and at which period caves and natural grottoes were the only places of devotion."

Referring to later stages, during which there arose "stupendous ecclesiastical structures," Tennent adds:—

"The historical annals of the island record with pious gratitude the series of dagobas, wiharas, and temples erected by" Devenipiatissa "and his successors."

A dagoba "is a monument raised to preserve one of the relics of Gotama . . . and it is candidly admitted in the *Mahawanso* that the intention in erecting them was to provide 'objects to which offerings could be made.'"

Here though we do not get evidence that the architects were the priests, yet other passages show that Buddhist temples were the works of converted kings acting under direction of the priests. Moreover, the original development of architecture for religious purposes, and the consequent sacredness of it, is curiously implied by the fact that the priesthood "forbade the people to construct their dwellings of any other material than sun-baked earth."

This last extract recalls the general contrast which existed in ancient historic kingdoms between the dwellings of the people and the buildings devoted to gods and kings. The vast mounds from which Layard exhumed the remains of Babylonian and Assyrian temples are composed of the *débris* of sun-dried bricks, mingled, doubtless, with some decomposed wood otherwise used for constructing ordinary houses. Layers upon layers of this *débris* were accumulated until the temples were buried, as some temples are even now being buried in Egypt. Whether it was because of the costliness of stone, or because of the interdict on use of stone for other than sacred purposes, or whether these causes co-operated, the general implication is the same—architecture began in subservience to religion (comprehending under this name ancestor-worship, simple and developed); and was, by implication, under the control of the priesthood. Such further evidence as Ancient Babylonia yields, though indirect, is tolerably strong. Saying of the temple and palace "solemn rites inaugurated its construction and recommended its welfare to the gods," and implying that its plan was governed by established tradition (of which the priests were by implication the depositaries) Perrot and Chipiez write:—

"Whether they belonged to the sacerdotal cast, we do not know. We are inclined to the latter supposition in some degree by the profoundly religious character of the ceremonies that accompanied the inception of a building, and by the accounts left by the ancients of those priests whom they called *the Chaldæans.*"

And since "when it [architecture] is carried so far as it was in Chaldæa it demands a certain amount of science," the priests who alone possessed this science must have been the architects.

Sufficient proofs of the alleged relation among the Egyptians are supplied by ancient records. Rawlinson says:—

"Although their early architecture is almost entirely of a sepulchral character, yet we have a certain amount of evidence that, even from the first, the TEMPLE had a place in the regards of the Egyptians, though a place very much inferior to that occupied by the Tomb."

Summing up the general evidence Duncker writes:—

"In the achievement won by Egyptian art the priests took a leading part. The buildings of the temples and the tombs of the kings could only be erected after their designs; for in these essentially sacred things, sacred measures and numbers, were concerned."

Some special illustrative facts may be added. Of Mentuhotep it is recorded that—

"As chief architect of the king he promoted the worship of the gods, and instructed the inhabitants of the country according to the best of his knowledge, 'as God orders to be done.'"

Here are passages relating to the 19th and 21st dynasties respectively. Bekenkhonsu, on his statue is made to say:—

"'I was a great architect in the town of Amon.' 'I was a holy father of Amon for twelve years.' 'The skilled in art, and the first prophet of Amon.'"

"Hir hor, first of a succession of priest-kings, calls himself, when represented by the side of the king:—'Chief architect of the king, chief general of the army.'"

And that the priest, if he did not always design, always directed, may be safely inferred; for as Rawlinson says, "it is . . . tolerably certain that there existed in ancient Egypt a religious censorship of Art."

Of evidence furnished by Greek literature, the first comes to us from the Iliad. The priest Chryse, crying for vengeance, and invoking Apollo's aid, says:—

"O Smintheus! If ever I built a temple gracious in thine eyes, or if ever I burnt to thee fat flesh of thighs of bulls or goats, fulfill thou this my desire; let the Danaans pay by thine arrows for my tears."

By which we see that the priestly function of sacrificer is joined with the function of architect, also, by implication, priestly. Later indications are suggestive if not conclusive. Here is a sentence from Curtius:—

"But the immediate connection between the system of sacred architecture and the Apolline religion is clear from Apollo being himself desig-

nated as the divine architect in the legends concerning the foundation of his sanctuaries."

And further on he writes—

Thus "schools of poets came to form themselves, which were no less intimately connected with the sanctuary than were the art of sacred architecture and hieratic sculpture."

But, as we have before seen, the lack of a priestly organization in Greece obscured the development of the professions in general, and that of architects among others.

That much of the Roman cult was not indigenous, and that importation of knowledge and skill from abroad confused the development of the professions, we have seen in other cases. The influence of the Etruscans was marked, and it appears that of the religious appliances derived from them, architecture was one. Duruy writes:—

"Etruria also furnished the architects who built the *Roma quadrata* of the palatine, and constructed the first temples; she provided even the flute-players necessary for the performance of certain rites."

But the identity eventually established between the chief priest and the chief architect, in the person of the *Pontifex maximus*, while it illustrates the alleged connection, also reminds us of one of the original causes for the priestly origin of the professions—the possession of learning and ability by priests. Among primitive peoples, special skill is associated with the idea of supernatural power. Even the blacksmith is, in some African tribes, regarded as a magician. Naturally, therefore, the Roman who either first devised the arch, or who first conspicuously displayed skill in constructing an arch, was supposed to be inspired by the gods. For though the arch is now so familiar that it does not excite wonder, it must, when first used, have appeared an incomprehensible achievement. Hence a not unlikely cause, or at any rate an ancillary cause, for the union of priest and bridge-builder.

After the fall of the Roman Empire the social disorganization which arrested mental activities and their products, arrested architecture among them. Its re-commencement, when it took place, was seen in the raising of ecclesiastical edifices of one or other kind under the superintendence of the priestly class. Referring to the state of things after the time of Charlemagne, Lacroix writes:—

"It was there that were formed the able architects and ecclesiastical engineers who erected so many magnificent edifices throughout Europe, and most of whom, dedicating their lives to a work of faith and pious devotion, have, through humility, condemned their names to oblivion."

Speaking of France, and saying that up to the tenth century the names of but few architects are recorded, the same author writes:—

"Among them, however, are Tutilon, a monk of Saint Gall, . . Hugues, Abbot of Montier-en-Der; Austée, Abbot of St. Arnulph, . . . Morard, who, with the co-operation of King Robert, rebuilt, toward the end of the tenth century, the old church of St. Germain-des-Prés, at Paris; lastly, Guillaume, Abbot of St. Benignus, at Dijon, who . . . became chief of a school of art."

And he further says:—

"In the diocese of Metz Gontran and Adélard, celebrated Abbots of St. Trudon, covered Hasbaye with new buildings. 'Adélard' says a chronicler 'superintended the construction of fourteen churches.'"

This association of functions continued long after. According to Viollet-le-Duc, the religious houses, and especially the abbey of Cluny, during the eleventh and twelfth centuries, furnished most of the architects of Western Europe, who executed not only religious but also civil and perhaps military buildings.

The differentiation of the architect from the priest is implied in the following further quotation from Lacroix:—

"It was, moreover, at this period [of transition from Norman to Gothic] that architecture, like all the other arts, left the monasteries to pass into the hands of lay architects organized into confraternities."

Similar is the statement of Viollet-le-Duc, who, observing that in the thirteenth century the architect appears as an individual, and as a layman, says that about the beginning of it "we see a bishop of Amiens . . . charging a lay architect, Robert le Luzarches, with the building of a great cathedral." A curious evidence of the transition may be added.

"Raphael, in one of his letters, states that the Pope (Leo X) had appointed an aged friar to assist him in conducting the building of St. Peter's; and intimates that he expected to learn some 'secrets' in architecture from his experienced colleague."

Passing to our own country we find Kemble, in *The Saxons in England*, remarking of the monks that—

. . . "painting, sculpture, and architecture were made familiar through their efforts, and the best examples of these civilizing arts were furnished by their churches and monasteries."

In harmony with this statement is that of Eccleston.

"To Wilfrid of York and Benedict Biscop, Abbot of Wearmouth in the seventh century, the introduction of an improved style of architecture is due; and under their direction several churches and monasteries were built with unusual splendor."

And afterward, speaking of the buildings of the Normans and of their designers, he says of the latter—

"Among the foremost appeared the bishops and other ecclesiastics, whose architectural skill was generally not less effective than their well-bestowed riches."

How the transition from the clerical to the lay architect took place is not shown; but it is probable that, eventually, the clerical architect limited himself to the general character of the edi-

fice, leaving the constructive part to the master-builder, from whom has descended the professional architect.

Chiefly for form's sake reference must be made to the gathering together and consolidation which, in our times, has been set up in the architect's profession. There is little to remark further than that the members of it, having been but few during earlier periods, when the amount of architectural building was relatively small, segregation and association of them could scarcely occur. Recently, however, there has been formed an Institute of Architects, and the body of men devoted to the art is tending more and more to make itself definite by imposing tests of qualification.

At the same time cultivation of the art and maintenance of the interests of those pursuing it are achieved by sundry special periodicals.

THE ELECTRIC FURNACE IN CHEMISTRY.

By M. H. MOISSAN.

THE reverberatory electrical furnace with movable electrodes, which we devised in 1892, and in which we have made many improvements, is very simple in construction, has been of great service, and has permitted us to deal with problems which have been hitherto insoluble. By means of this apparatus we have been permitted, by obtaining a sufficient temperature, to produce the diamond, to crystallize metallic oxides, to reduce those which have hitherto been refractory, to melt metals heretofore infusible, to distil lime, silica, zirconia, and carbon, and to cause an abundant volatilization of such metals as platinum, copper, gold, iron, manganese, aluminum, and uranium. Some bodies that could not be brought to a condition of fusion, like magnesia, uranium, tungsten, and molybdenum, could be made to assume the gaseous state in the electric furnace. In our studies we have frequently dealt with the vapor of lime and silica.

When using the currents of machines of from one hundred to three hundred horse power, we have in the midst of the furnace the temperature produced by the electric arc; a few centimetres beneath, the crucible containing the matter to be experimented upon; and at the bottom, a mass of quick-lime in full ebullition. The imperfect conducting power of this substance is a fortunate quality for us. It isolates the heat which the electric arc can furnish into the smallest possible cavity.

This new apparatus permits us to approach the study of a whole series of simple bodies which have been till now mere

laboratory curiosities, because of the want of adequate means of obtaining them.

It is easy, with the aid of the electric furnace, to produce abundant meltings of chromium by reducing the sesquioxide. This melting, refined, yields chromium, an unoxidizable metal very different from the specimens which have been hitherto obtained. It can be filed like iron, and takes a fine polish. Chromium, then, more infusible than carbon, can now be used in preparing alloys without the need of the intervention of ferro-chromium, which has the disadvantage of containing up to ten per cent of carbon.

This preparation opens the way for the effective study of the alloys of chromium. In combination with aluminum or copper, it gives interesting results. Pure copper, alloyed with 0·5 per cent of chromium, assumes a double resistance and suffers less change than copper in contact with moist air.

Molybdenum, previously unfused, can also be obtained in notable quantities. By heating, in a continuous electric furnace, a mixture of oxide of molybdenum and charcoal, a melting of the metal is obtained which flows readily and can be easily molded. It furnishes a definite carburet, very well crystallized. It is refined by a new heating in the electric furnace, with an excess of oxide of molybdenum. The melted metal thus obtained has a fine grain and a brilliant surface. It can be filed, and forged, at a red heat, upon the anvil; and with iron it furnishes a steel that can be tempered. These are all new properties.

Tungsten has been heretofore known to chemists only as a powder. Under the action of the electric arc, the oxide of tungsten is reduced by means of carbon, and gives in a few minutes a well-melted bottom, covered with a fine layer of the blue oxide of tungsten. This metal, which is still more infusible than chromium and molybdenum, can be liquefied with great facility. It does not seem to have a strong affinity for carbon, and is obtained without special precautions as one of the purest metals we have prepared.

The different oxides of uranium can not be reduced by carbon at the ordinary temperatures of our furnaces; but when a mixture of the sesquioxide of uranium and carbon is subjected to the high temperature of the electric furnace, the reduction takes place in a few instants. After cooling, an ingot may be drawn from the crucible possessing a brilliant fracture and great hardness. When this uranium is slightly carbureted, it presents the property of striking fire in contact with flint. The particles thrown off burn with an intensity and an energy far superior to those exhibited by a piece of iron.

All these simple bodies melt at more or less high temperatures.

By the side of them we may place other metals the minerals of which are rare—such as zirconium and vanadium.

Vanadium, on which Prof. Roscoe has made some interesting studies, was not known, except as a gray powder including hydrogen, oxygen, and a little of some alkali metal as impurities; but Prof. Roscoe has had the pleasure of seeing in my little laboratory at the École de Pharmacie several hundred grains of it, under the form of cast metal pieces, having a crystalline and brilliant fracture. This simple body, the mineral of which occurs more extensively than is generally supposed, is very difficult to melt, it hardly liquefying in the current produced in the Edison dynamo by an engine of forty horse power.

In our studies of titanium, a mixture of charcoal and titanic acid gave, with a machine of four horse power, protoxide of titanium; with a machine of forty-five horse power we obtained only nitride of titanium; under the action of currents of from one hundred to three hundred horse power we prepared by kilogrammes a crystallized carbide, and then real titanium, the properties of which are wholly different from those formerly attributed to the gray powders that bore that name. This substance takes fire in fluorine; decomposes water only at a bright-red heat; and possesses the curious property of burning in nitrogen at a high temperature, yielding the nitride of titanium studied by Friedel and Guérin. It readily combines with carbon and silicon, but does not unite with argon. Its melting point is very high, it resembling carbon in that respect. It differs from carbon, however, in the fact that while carbon under the ordinary pressure and at a great elevation of temperature passes from a solid to a gas without becoming liquid, titanium can, in the electric furnace, be liquefied and then volatilized.

Most of the simple bodies furnish, with carbon, well-defined combinations, crystallized and stable, at a high temperature, which are destined to furnish a new chapter to mineral chemistry.

All these simple bodies which we have obtained by kilogrammes in the electric furnace form also borides and silicides finely crystallized and so hard that some of them easily cut the diamond. What part they are to have in the manufacture of steel, and whether they are destined, like chromium, to give new properties to iron, are questions for the future to answer. But a new chemistry of high temperatures is forming, from which industry will most likely draw numerous applications.

It is recognized on all sides that some of our industries are about to suffer important modifications through the use of electrical forces. We ask of the forces of Nature all they can yield; and they are capable of easy use when transformed into electricity.

—*Translated for the Popular Science Monthly from La Nature.*

Correspondence.

THE DRIFT OF POPULATION IN FRANCE.

Editor Popular Science Monthly:

SIR: My article entitled Has Immigration increased Population? having been sent to you two years ago, contains some observations the force of which has been greatly modified by time, and would have been omitted or expressed very differently if I had been writing now. I had corrected them on the proofs, but the corrections unfortunately failed to reach you before you were obliged to go to press. Waiving consideration of the lesser errors which have thus arisen, I write you this letter as my only means of correcting the one of greatest importance. In speaking of France, I said that it could not be used as an example to show that advanced civilization lessens the rate of increase of population, because, although "the French annual rate of increase sank very low during the four or five years previous to the Prussian War, being only seven per thousand inhabitants in 1870, it has since then steadily risen and in 1890 was thirty-seven per thousand."

At the time I was writing, the statistics obtainable in this country seemed to bear me out in the above assertion. But since then we have the French statistics down through 1893, which show that the population has again declined. It is rather strange, by the way, that some of these statistics should be so uncertain. For example, some authorities tell us that in 1890 the French population increased 38,446, and others tell us that in that year it diminished by that same figure. But, nevertheless, the statistics taken as a whole seem to show a decided falling off since 1890. This, however, does not alter my main argument, and if my corrections had been in time the passage above quoted, and the paragraph in which it occurs, would have been replaced by the following:

"But civilization is a broad term and has different meanings in different countries. While it may be true that the form of civilization which prevails in France, or certain ideas and habits of the French people, may cause a decrease in population, it does not necessarily follow that civilization in other countries has that effect; and as a matter of fact it does not."

I should also have inserted this:

"More than one hundred years ago Franklin noticed that countries many of whose people migrate are not thereby depopulated, but on the contrary often increase their population much more rapidly than would be expected. His observation has been confirmed by later experience (Mayo-Smith's Statistics and Sociology, pp. 319, 336). The emigration merely makes room for a greater number of births, so that population increases as fast as it otherwise would, if not faster. It is the country to which the emigrant goes that is more likely to suffer. Immigrants take the place which would otherwise be filled by the natural increase of the natives. The pressure of the immigration decreases the size of the native families; and in the case of the United States, although the foreigner may, under many circumstances, have a higher birth-rate, yet the mortality among his children is so much greater than among the children of the natives that there is no gain in population."

Yours truly, SYDNEY G. FISHER.

December 1, 1895.

Editor's Table.

PAUSE, PERHAPS, NOT REACTION.

IT is freely alleged in various quarters, occasionally with regret but more frequently with more or less exultation, that the present is a period of intellectual reaction. Science, it is said by some, has been moving too fast and has not made good its more advanced positions. It has attacked questions that were beyond its grasp, and has had to retire in discomfiture. It has made promises to mankind which it has not fulfilled, and which evidently it is not going to fulfill. Its watchwords have lost their power—so we are assured—and the comfort-

able doctrines of the past are in a fair way to recover their former prestige and influence. It is needless to say that we do not accept this view of the situation. In cosmic and in human affairs there is certainly a law of rhythm, as Mr. Spencer has so copiously proved in a celebrated chapter; but rhythm is one thing and reversal of a main movement is another. There will come times when men will in a measure tire of speculation, and seek rather to rest in a partial conclusion than to pursue further voyages of discovery into the unknown; and such a time may be expected after a period of active and rapid theoretical advance. At such a moment of lull it is not surprising if the Philistines of the intellectual world, who had been more or less in hiding while the forward movement was at its greatest intensity, should venture from their fastnesses and indulge in a few songs of triumph; but this need not disturb the serenity of the army of progress. In due time the order to march will be given, and then the Philistines—will keep out of the way.

Such, we think, is the situation at the present time. The third quarter of the century was a period of almost if not of quite unparalleled scientific activity. It gave birth to the most important work of Spencer, Darwin, and the rest of the evolutionist school. It brought important discoveries in chemistry and biology, and rendered a great deal of so-called orthodox opinion in many departments of knowledge forever obsolete. The impetus of this great movement lasted undiminished for several years longer, and, if it has now slackened in any degree, it is that the specific need of the present day is rather a careful survey and classification of the results already obtained than a further development of theory. We want to know just where we are before we start again. To say that no opinions which were held with a good deal of confidence ten or twenty years ago have undergone any modification would be foolish. That is not the way in which science advances; it advances through constant rectification of its observations and adjustments of its point of view. A change of opinion may involve loss, perhaps fatal loss, to a system of thought founded on authority, but it means no loss to science, whose vitality can never be impaired by additional knowledge. As Mr. Spencer has lately found occasion to say, there may be much difference of opinion as to how species originate, but this does not in the least invalidate the great law of evolution, which finds illustrations on every page of the book of Nature. The heritage of Darwin may be divided, but at least no part of it is in possession of an antiscientific or antinaturalistic school. All who to-day grapple with the question of the origin of species do so on a basis of purely scientific observation and reasoning; and even if the problem had to be given up as too obscure—and it is quite possible that we do not even yet know how obscure it is—it would still remain a problem of science, not a problem of theology or metaphysics.

One most important characteristic of science is that it can never really be idle. If it is not doing one thing, it is doing another; and its humbler work—or what seems so—may be not less useful, may indeed be more useful, than its more ambitious efforts. There is no department of natural knowledge that is not day by day receiving accretions which all go to better in some way the position of man upon the earth. It will do no harm if for a time there is less vague talk in regard to the theoretical conquests of science: but there need be no abatement of the

confidence with which we hold that science is the power which transforms impressions of sense into conclusions of reason, which alone throws light on the constitution of the world in which we live, and which confers upon all human effort its highest possible efficiency. Knowing this, we know that the so-called "bankruptcy of science" is a contradiction in terms, the flippant invention of those with whom the wish is father to the thought. In a word, all is well; for whether the time be seed-time or harvest, whether the field, as we see it, be lying fallow or carrying a bounteous crop, science, the one abiding power and principle of fertility, is present with mankind, and its promise will not fail.

THE PROBLEM OF LIFE.

In the October number of the International Journal of Ethics Prof. William James, of Harvard, comes forward with his contribution to the much-discussed question, "Is Life Worth Living?" The conclusion, a sufficiently simple one, at which Prof. James arrives, is that life may be made worth living; but he only arrives at this very true conclusion after a considerable amount of laborious and, in our opinion, not wholly sound argumentation. It may be worth while, therefore, to go over the ground—so far as it can be done within our narrow limits—and see what view can reasonably be taken of the whole subject.

We are told by the writer mentioned that there are two recognizable sources of pessimism—or, in other words, of the feeling that life is not worth living—sensualism and overstudy, particularly of an abstract kind. It seems to us that a statement of this kind irresistibly suggests the corollary that pessimism, with its sickening doubts as to the value of life, may be avoided by avoiding its causes. Then, if so, why discuss it as if it were a substantive system of philosophy? It either is or is not a pathological condition: if it is, let us seek to remove it; if it is not, then it is all right. "It is a remarkable fact," says Prof. James at a later point in his article, "that sufferings and hardships do not, as a rule, abate the love of life; they seem, on the contrary, usually to give it a keener zest. The sovereign source of melancholy is repletion." Very true again; but what is the lesson? Simply that we should not abandon ourselves to repletion, and that in the interest of our children we should not satiate them with enjoyments. But elsewhere (page 7) the professor tells us that "pessimism is essentially a religious disease," consisting, in the form at least in which it attacks over-reflective minds, "in nothing but a religious demand to which there comes no normal religious reply." This, of course, sounds very philosophical; but it does not seem to be quite in agreement with the proposition so distinctly laid down, that pessimism may spring either from sensualism or from overstudy—"grubbing," as the writer expresses it, "in the abstract root of things." Supposing he who has been so "grubbing" stops doing it, or stops doing it in excess, and, by proper attention to hygiene, gets himself into capital physical and mental condition, what then becomes of the religious disease? Will it not vanish with its cause?

We fail to see, however, why pessimism should be considered as a religious disease in the case of the over-studious man and not in that of the over-sensual? By different routes both have arrived at the same goal—exhaustion; and it is hard to see why the pessimism of the one should have a more religious character than that of the other. Each has been brought

through his own injudicious courses into the same morbid condition of mind; each, consequently, on the strength of his own feelings asserts that life is not worth living; and each says what is not true. Each in his own way has disturbed, if not destroyed, the natural balance of his faculties and functions, so placing himself in a wrong and painful relation to the world in which he lives; and the true remedy would therefore seem to lie in undoing, if it be at all possible, the mischief that has been done. To trace pessimism, as Prof. James does, to certain specific causes, and then to propose to cure it by the application of a religious theory, is a little too much like trying to stay a pestilence by prayer instead of by sanitary measures. Supposing that a pestilence due to natural causes could be stayed by prayer, it would require a perpetual miracle to keep it from breaking out again so long as those causes were not removed. Therefore, before we can follow Prof. James in seeking a religious remedy for pessimism, we must unlearn the lesson he has himself taught us, that its origin may be found in such avoidable errors as undue self-indulgence (repletion), sensualism, and overstudy. A dyspeptic takes very gloomy views of human affairs, but what is the use of arguing with him? What he wants is new life in his digestive organs. Pessimism, as a creed, will only deserve to be argued with when it can be shown that it claims its victims, not less among those who have wisely husbanded their powers and in every way respected the laws of life, than among those who have wasted their substance and set the laws of life at defiance.

It is evident that Prof. James has been so far affected by the pessimism of studious souls as to have conceived a very unfavorable opinion of the apparent order of the universe. He does not, however, give us as clearly to understand as we could wish wherein this somewhat extensive institution fails to meet his private views—what he would like it to be that it is not, or not to be that it is. He quotes with evident sympathy some appalling verses by the author of The City of Dreadful Night—verses which would have almost sent a shudder through the rebellious soul of Omar Khayam himself; and he tells us that he fairly rejoices over the downfall of that form of natural religion—fit only for backward and barbaric peoples—which consists in "the worship of the God of Nature, simply taken as such." "There were times," he says, "when Leibnitzes, with their heads buried in monstrous wigs, could compose Theodicies, and when stall-fed officials of an established church could prove by the valves of the heart and the round ligament of the hip joint the existence of a 'Moral and Intelligent Contriver of the World.' But those times are past, and we of the nineteenth century, with our evolutionary theories and our mechanical philosophies, already know Nature too impartially and too well to worship unreservedly any god of whose character she can be an adequate expression. . . . To such a harlot" (as Nature) "we owe no moral allegiance. . . . If there be a divine spirit of the universe, Nature, such as we know her, can not possibly be its ultimate word to man." This, on the whole, does not seem to us very convincing writing for a Harvard professor. The "monstrous wig" of Leibnitz did not so stifle his brains as to prevent his discovery of an admirable form of the calculus; and, among the "stall-fed officials of an established church," the first that occurs to mind—certainly the most illustrious—was precisely he who pointed out (Samuel

Butler was his name) the many difficulties and perplexities which confront us in our study of the order of Nature. What special advantage flows from calling Nature a "harlot" we are at a loss to imagine; but we do not find it hard to imagine what evil may ensue therefrom. If that Ultimate Power into communion with which the professor is so anxious to bring us has really given us a harlot world in which to pass our probation—well, it would really seem as if, to put it mildly, our education has not been well provided for. Human parents do not choose such associations for their sons and daughters. And yet, in spite of its harlotry, "this world of Nature," we are told, "is a sign of something more spiritual and eternal than itself." It is also spoken of as "a mere sign or vision of a many-storied universe in which spiritual forces have the last word," and this in spite of the assertion made in the same sentence, that "circumstances on the natural plane" create the strongest presumption that life is not worth living. Verily, "too much grubbing in the abstract root of things" does produce a somewhat tangled condition of the understanding, as well as an ugly bent toward pessimism.

If we once settle it in our minds that pessimism, or, as Prof. James otherwise describes it, the suicidal tendency, is a disease, there is only one question worth discussing in connection with it, and that is how to prevent it. It seems to us that the way is indicated with great clearness and simplicity by the philosopher who, anticipating the Harvard professor by over two thousand years, briefly announced that "much study is a weariness of the flesh." What does that philosopher further teach? He teaches the lesson that has never yet sunk deeply enough into the general mind, that youth is the time when the character should be fortified against the trials and disappointments of later life. His simple but expressive language may perhaps be not improperly recalled: "Remember now thy Creator *in the days of thy youth*, while the evil days come not, nor the years draw nigh when thou shalt say, I have no pleasure in them." Will any one say that the doctrine of evolution has rendered such advice as this obsolete? It would be a shallow person, in our opinion, who would raise such an objection. What the preacher saw and felt was that youth was a period which, if rightly used, would establish the whole life on sure foundations. The remembering of one's Creator means little if it does not mean acquiring a knowledge of and reverence for the laws which ought to govern human life, the formation of sound physical and intellectual habits, and of pure and wholesome associations. It means, if it means anything, the discerning of a true ideal of life, and the earnest and loyal adoption of that ideal as something to be sacredly guarded to life's end. Youth is the one period of life that is fully capable of this, and therefore it is in youth and only in youth that our nature can be rendered, as it were, immune against pessimism. Prof. James may say that this is taking a religious view of life, and that so far we agree with him. We claim that if our view is religious it is also scientific, inasmuch as it takes, or aims at taking, full account of all the conditions of the problem. The difference between us, however, is, as we think, real and important. He prescribes religion somewhat as a doctor would a drug, as a tonic for exhausted minds. We postulate a certain view and government of life, not as a remedy for existing disease, but as the condition

and guarantee of mental, moral, and physical health. And — what we think is not unimportant—our point of view exempts us from all temptation to malign the world, which is the theater of our efforts, or to perform a war dance over the downfall of natural theology. We believe Prof. James could preach a much better and more useful sermon from the verse above quoted than he has done in the essay that has been the subject of our remarks. Or, if he wants a classical authority, let him take the words of Sophocles, who says that, "of those whose lives are kept in the right course, the majority are saved through obedience." Here we have the true counter-blast to pessimism in a simple declaration of the law of life: whoso heeds it is wise; whoso heeds it not will not be won to happiness by argument.

SCIENCE AND TEMPERANCE.

WE commend to the attention of our readers an article in this number of the Monthly, by President Jordan, of Stanford University, on the subject of "Scientific Temperance." An organization noted more, perhaps, for its emotional than for its rational impulses has, it seems, taken into its own hands the direction of what shall be taught in the schools of the country regarding the effects of alcohol on the human system. If such teachings were characterized by that avoidance of excess which is so desirable where the appetite for drink is concerned, there would be little occasion to complain. Indeed, we believe an honest zeal in the cause of temperance is entitled to the highest respect and to a wholehearted support. There is no denying that much the greater part of the crime and misery with which society is afflicted is caused by the use of alcohol in one form or another, and it has always been the practice of this magazine to aid in the enlightenment of the public on this class of questions whenever the facts warranted such a course. But, on the other hand, we are equally ready to condemn a kind of teaching that tends to dwarf the truth, or to dress it up in a fictitious garb, no matter how good in itself the object may be that it is sought to promote.

In the present case, with the desire apparently to make the instruction concerning the effects of stimulants and narcotics more potent for good, altogether erroneous ideas are conveyed to the pupil regarding the science of the subject. What is tacitly represented as the established results of scientific research is embodied in so-called scientific textbooks as a part of the truths of physiology, but this so much exceeds the facts that the pupil, if not actually misled, is likely to carry away distorted impressions, or wholly lose sight of the modicum of truth which science has been able to work out of the problem. If it were the science of the matter pure and simple that our reformers were after, the two pages of the Indiana text-book that President Jordan quotes would amply cover the ground, and leave space for a few facts that bear the other way, which as a part of the results of research deserve to be impartially presented. Such a treatment might fitly be labeled "scientific," and escape the charge of false pretense. On the contrary, to give the subject sixty pages out of four hundred, with its moral and social aspects lugged in, and to call that "human physiology," is a lesson in deceit that should be denied a place in our public schools. No competent physiologist would make such a book, and no conscientious teacher of science, if permitted the right of choice, would place it in the hands of

his pupils, yet either is certainly better fitted to judge what shall be taught as physiology than the indifferent legislator or the reckless reformer.

From the point of view of the temperance cause itself the case seems little better. The false notions of physiology that this kind of instruction is calculated to foster are sure sooner or later to react. The child learns the pseudo facts. They are so striking and so frequently reiterated that he remembers them. But at a later period he discovers that some of them are doubtful, that others were greatly exaggerated, and that not a few were wholly erroneous. Further study will only confirm this conclusion, when it is not unlikely that he will go to the other extreme and reject all he has learned on the subject as unworthy of respect—a state of mind the very opposite of the one intended. But this is not the worst of it. The discredit into which it tends to bring the study of physiology itself is still more unfortunate. The widespread ignorance of this subject is responsible for a vast amount of suffering and disease, much of which might be avoided and some perhaps removed were a knowledge of physiology more generally diffused. To convey such knowledge uncolored and without exaggeration is a worthy object; but to falsify it, calling the falsification science, and compel its acceptance as such by authority of law, is very much like causing the state to join hands with the counterfeiter, and is scarcely entitled to more respect.

Scientific Literature.

SPECIAL BOOKS.

In three consecutive volumes of the International Education Series an abundant supply of material is furnished to the kindergartner or the mother who would use kindergarten methods.* The first consists of fifteen of Froebel's essays which, in the original tongue, were collected into a volume by Dr. Wichard Lange. From these essays may be learned Froebel's own ideas of the significance of the first five "gifts" of the kindergarten. The ball, he says, gives the child a welcome opportunity to contemplate, to grasp, and to possess a whole; it develops the muscular sense and the control of the muscles of the hand and arm; and the various plays with the ball in which the mother may lead the child tend to awakening and fostering the powers of its mind to compare, to conclude, to judge, and to think. The contrast between the sphere and the cube is highly instructive: the one having each part of its surface of the same form as every other part, standing on a point, and easily movable, the other with sharp edges and corners, resting on a broad base, and requiring some force to move it. From the cube, variously divided, the child learns the ideas of parts making up a whole, of one form appearing in different sizes,

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* Friedrich Froebel's Pedagogics of the Kindergarten. Translated by Josephine Jarvis. Pp. 337, 12mo.

The Mottoes and Commentaries of Friedrich Froebel's Mother Play. Translated by Henrietta R. Eliot and Susan E. Blow. With an Introduction. Pp. 316, 12mo.

The Songs and Music of Friedrich Froebel's Mother Play. Prepared and arranged by Susan E. Blow. Pp. 272, 12mo. New York: D. Appleton & Co. Price, $1.50 each.

of a form bounded by unequal faces, etc. The various modes of using the gifts, which are depicted in illustrations, suggest many movement plays, and these Froebel describes, giving also the words of songs to accompany them. He also describes a pleasant way of learning to write and read. Froebel was a pioneer in child study, and in his description of kindergarten plays he is constantly calling attention to the development of the child's faculties which the attentive kindergartner may observe.

In the other two volumes we have Froebel's Mutterspiel and Koselieder reproduced in English. Froebel indicated how each of the mother-plays should be played by means of a group of pictures surmounted by a "motto" consisting of eight or ten lines of verse. These quaint pictures and the mottoes in the original language are reproduced in each volume. The first, which may be called the mother's volume, contains also free renderings of the mottoes in English verse, by Mrs. H. R. Eliot, together with prose translations, by Miss Blow, of the commentaries that accompanied the plays. Miss Blow has also furnished an introductory essay on the philosophy of Froebel, and, that nothing of the master's thought may be lost through rendering his homely lines into English verse, she has given prose translations of the mottoes in an appendix. The companion or children's book contains the same pictures with short pieces of verse on their subjects by Emily H. Miller, Emilie Poulsson, Laura E. Richards, and other writers. Following these is music for them and for some others to the number of eighty-three in all. In this volume many of the pictures in the groups are repeated on a larger scale, so as to bring out their details more clearly. Many of the melodies originally used in the mother-play having been pronounced unsuitable by competent judges, other music is here supplied from sources of recognized merit. In every part of these two volumes the directing hand of that able kindergartner, Miss Susan E. Blow, is apparent. Kindergarten teaching can be conducted by those who have a genius for it without such helps as these books afford, but it is hard to imagine that a teacher who had once used them would be willing to give them up.

In his work on *Money and Banking** the editor of the New York Evening Post gives connected form to the principles of finance which he has studied and discussed for many years past. His method is that of the historian who accounts for an event by circumstance, pressure, ignorance—occasionally by knowledge fortunately joined to courage. His book is a mine of sifted fact, with clear and convincing deductions wherever these are warranted, with a judicial presentation of both sides of a case where a decision is as yet to be found.

Stripped of its entanglements the money question is simple enough. Mankind has chosen precious metals among commodities as means of exchanging all the rest and as standards of value. Real money, then, is metallic coin, authenticated by the stamp of a mint as to quantity and fineness. For generations down to 1873, both gold and silver circulated together in civilized countries at a ratio of about one to fifteen, the fluctuations from that ratio being too inconsiderable to cause serious difficulty. With the discovery in 1873, and since, of new and rich deposits of silver,

* Money and Banking illustrated by American History. By Horace White. Pp. 488, 12mo. Boston and London: Ginn & Co. Price, $1.50.

with constant improvement in processes for separating the metal from its ores, silver in twenty years fell one half in value as compared with gold. The difficulty inherent in trying to keep two commodities at a fixed relation to each other—that is to say, the attempt to maintain an unchanged price for silver in terms of gold—plainly had passed beyond the utmost power of legislation. Nevertheless, at the instance of mine owners legislation in 1878 and 1890 was invoked against facts geological and chemical, with the result that the Federal Treasury bought a mass of silver to-day worth $234,000,000 less than it cost. The new plentifulness of silver has strengthened the preference for gold as the sole standard of value—a preference always felt by the richer among the nations from the great value which the yellow metal possesses in small bulk. And what if silver should become cheaper still? It is the fear that something short of 23·22 grains of gold will be paid by the borrower of a dollar that has tightened the purse-strings of capital just at the time when good faith toward creditors would have bred a confidence indispensable for an assured revival of business. Of equal moment with the agitation for the free coinage of silver as a source of financial misgiving, Mr. White stigmatizes the Legal-Tender Act. This Act has led the American people to believe that the Federal Government has only to set a printing press in motion to create money, as by Heavenly fiat. But the paper representatives of money inspire no confidence unless they stand for a commodity, gold, in the full measure to which at a time of panic that commodity will be demanded. What makes this matter of sound money of supreme importance is that on money as on a pivot turns so much more than itself—the whole fabric of manufacture, trade, and commerce. To tamper with the standard of value, to debase it, to lay undue burdens upon it, is as mad as the act of an engineer who skimps substance for his fly-wheel, scamps its workmanship, and who, defying the laws of poise and strain, brings a vast network of machinery to ruin.

Mr. White outlines the salient features of American banking, with its dreary record of overreaching, ignorance, and recklessness, relieved here and there by examples of sound principle and careful practice as in New York, Massachusetts, and Louisiana. He gives reasons for regarding Scotch banking as the best in the world, and points to Canada as successfully copying many of its methods. A great bank with many branches, on the Scotch plan, is a chain of lakes, each borrowing or lending with mutual benefit; the American method of isolation exposes every bank to alternate drought and flood. That it is no proper function of government to be a banker Mr. White abundantly proves. As the bonds upon which the existing national bank notes are based are disappearing, it is imperative that a new basis for this note issue be found. Mr. White presents the "Baltimore plan" and Secretary Carlisle's proposal, leaving the decision with those who must arrive at it.

Any one who wishes to know what can be said for the single-tax idea clearly and soberly, with the aid of statistics, and quite apart from any demagogic appeals to class prejudice, would do well to read Mr. *Shearman's* book in the Questions of the Day Series.* The author starts with

* Natural Taxation. By Thomas G. Shearman. Pp. 229, 12mo. New York and London: G. P. Putnam's Sons. Price, $1.

the proposition, which many economists deny, that taxation can be based on scientific principles; in other words, that money for the needs of government can be so raised as to take advantage of the natural laws that operate in society instead of running counter to them. The principle of plucking the greatest quanitity of feathers with the least squawking is certainly antiquated and unworthy of a mature and intelligent people. Our taxation should be scientific, and if the scheme advocated by Mr. Shearman really has that character, he has brought the right article to market. Many persons who are not prepared to accept the single tax as a remedy will admit most of what he says in regard to the evils of indirect taxation. He affirms that direct taxation is practicable, but of the three forms now in use—the income, succession, and general property tax—he deems the second useful only as an adjunct, while the other two, because of the premium they put on fraud and other objections, should never be used. A tax on land he calls the natural tax, because it can not be evaded, and because its proper distribution is automatically determined very much as ground rent is regulated by the market. In reply to the objection that such a tax would be shifted upon tenants, he cites "not only the entire school of Ricardo and Mill, but also nine tenths or more of other economic writers," as denying the possibility of such a transfer. In this respect he notes a difference between a tax on land and one on buildings. It is obvious that the landless class would be greatly benefited by exemption from all direct or indirect taxation. Mr. Shearman also maintains that the landowners, taken as an entire class, would also bear a smaller burden than now, because they would be exempt from taxes on personal property, indirect taxes, and the cost of collection and other burdens incidental to these modes of taxation. Some of the landowners would have a heavier burden than now. Mr. Shearman estimates that this would fall on fifty thousand of the six million families in the United States who own land. These fifty thousand own thirty per cent in value of all the land in the country, and also get almost all the benefits arising from the monopolies fostered by the present mode of taxation. He takes especial pains to show that the farmers need have no alarm at the land-tax proposition, and affirms that this plan, in addition to its other benefits, "would bring about a just distribution of wealth, would give a perpetual stimulus to industry and production, would greatly increase wages, would increase the profits of capital, would give a security to property now unknown, would encourage manufactures, commerce, and agriculture, and would incidentally solve many social problems which under present conditions seem almost insoluble." Mr. Shearman has not made his programme attractive enough, or, rather, he has not given it the right kind of attractions. The masses do not want a just division of wealth any more than the classes. Every mother's son of them is perfectly willing that a few shall have big prizes at the expense of the many, if only he can be one of the few; and in a democratic country, where it is possible for a poor boy to become president of a railroad, he is constantly hoping that next week or next year will bring him some undeserved advantage over his fellows. Even if a majority of the voters in the United States were convinced that any economic reform would benefit them all, they would need to have the lottery spirit educated out of them before they would adopt it.'

GENERAL NOTICES.

SINCE the establishment of the cell theory by Schieden and Schwann in 1838–'40, it has been recognized that a clear understanding of the processes which go on in the body, both physiological and pathological, and of their relations to parent and offspring, can only be obtained through a study of the cell. This study has thrown new light on many obscure points in heredity, and has revolutionized our theories of the "vital process." Such books as the one before us* are the cause as well as the result of such investigations—through their attractiveness stimulating the student to renewed effort. This one is a series of micro-photographs taken from sections of the eggs of the sea urchin and so arranged as to illustrate the principal phenomena in the fertilization and early development of the animal egg. The photographic reproductions are accompanied by a critical description and drawings illustrating every stage, and are preceded by a simple introductory account of the recent history and growth of the science. The refined histological technique and the manual skill necessary for original work of this quality are rarely at the command of the student. He has to get his knowledge from text-books, hence an accurate reproduction of the various specimens is quite essential. The photographs in this work were taken with especial care, not retouched, and reproduced in the prints as closely as possible. The book is unique in containing the first satisfactory series of photographic representations of the early history of the ovum. Prof. Wilson is to be congratulated both as to his own work and in having so skillful a collaborator as Dr. Leaming.

The author of this book,† who is the instructor in physics in the English High School of Boston, has been before the public as an author of text-books on physics for the past thirteen years. His latest production is characterized by a fullness which he intends to be a protest against "smaller books," "cheaper books," and "primers of science." "Education in physics," he affirms, "implies the presentation of the great truths of that science in their *unmutilated* form, the indication of their relations to one another, and the furnishing the student an opportunity of observing and exercising the logical processes that have led to the discovery of those truths. Any text-book that aims to introduce the student to a study of such importance and such inexhaustible possibilities should not lose sight of this truth and encourage mere *dilettanteism*." Accordingly, he supplements his statement of physical laws by a store of concrete applications and other illustrative matter. The book contains a "high-school" course and an "advanced" course, the latter comprising the former and additional matter distinguished by indenting. Some illustrative experiments are given, but the work is not intended to serve as a laboratory manual. A considerable number of problems and exercises have been inserted, a key to which is furnished to instructors. There are nearly five hundred illustrations, and a colored chart showing spectra and combinations of colors.

An experimental laboratory has, with the growth of modern methods of teaching, become almost a necessity in the study of botany. The book before us* is designed to aid and direct experimental study. As to the scope of his book the author says: "With the rapid advance of investigation it is next to impossible that an elementary laboratory manual should include the latest results, especially when the essential points of many of them may yet be in controversy, and need the critical treatment which is certainly not within the province of a work of this character. In the hands of an instructor in touch with current botanical thought such deficiencies are easily supplied. The present work consists of a series of ex-

* Atlas of the Fertilization and Karyokinesis of the Ovum. By Edmund B. Wilson, Ph. D., with the co-operation of Edward Leaming, M. D. Pp. 82, quarto. New York and London: Macmillan & Co. Price, $4; 17*s*.

† The Principles of Physics. By Alfred P. Gage. Pp. 634, 12mo. Boston, U. S. A., and London: Ginn & Co. Price, $1.55.

* Experimental Plant Physiology. By D. T. Macdougal. Pp. 85, 8vo. New York: Henry Holt & Co. Teachers' price, $1.

periments selected to illustrate the habits and life history of plants." The author was the translator of Oel's *Pflanzenphysiologische Versuche*, and his book is the outcome of comments and suggestions from laboratories in which this translation has been in use. The general form of Oel's manual is followed; many cuts and a few paragraphs from the translation are used; but it has been modified and reduced in size to conform more nearly to the needs of American primary students. The text is admirably clear and the experiments instructive and easily performed.

Prof. *L. H. Bailey* has compressed a wonderful amount of information between the covers of his *Rule-book*.* While of most value to the fruit-grower, truck-gardener, or florist, many of its directions, recipes, and tables are needed by every person who has a garden plot or a lawn. It contains directions for making and applying insecticides and fungicides, for preventing the depredations of small animals and birds, and for making and taking care of paths and lawns; recipes for grafting waxes, cements, paints, and glues, tables of weights of seeds, quantities required for an acre, time for planting, time of germinating and maturing, directions for keeping fruits and vegetables, for predicting the weather, for—but we have not space to give a full table of contents. This is a third edition of the book, revised and extended, and apparently well-nigh perfected. We have not seen a better seventy-five cents' worth of handy literature in many moons.

Educational methods are being so much discussed to-day that any publication dealing with this subject is of special interest. Prof. *Munroe's* book† is a history of the changes which have come about in the pedagogist's point of view since the Renaissance. He sketches the revolt against mediævalism, with Rabelais as the moving force. Francis Bacon does the same duty in the movement against classicism. The author says that Descartes was the greater thinker, but believes that he was less of a power at the time than Bacon. In the fourth chapter he narrates the downfall of feudalism and the part which Comenius played in it. In Chapter V, The Child has Senses to be Trained, the effect of the teachings of Montaigne and Locke are reviewed. The Jansenists and Fénelon, Rousseau, Pestalozzi and Froebel, and Women in Education each have a chapter. The author's views may be seen in the following passages taken from the last page of the book: "The new conception of the schoolmaster's task makes the educational problem simpler. . . . Comenius's 'mother-school,' 'that should exist in every house,' is becoming possible; upon the fundamental plan of such a mother-school all education must be shaped. It is no longer a simple question of the intellectual value of this study and of that; it is no longer to be decided what manner and quantity of information shall be given; it is a question now of determining those subjects and those methods which shall best supplement and carry forward the training of character, the real education to true manhood and true womanhood that is or ought to be given in the home under the parents' guidance."

Biology is attracting increasing attention from students of science. In its study now lies the chief hope of solving the questions of heredity and organic evolution. The book before us* is the third publication from a series of biological lectures which are delivered every summer at the Woods Holl Marine Laboratory. The first volume was received so favorably in 1890 that the authors were encouraged to continue their publication. This number contains thirteen lectures. Among them are Life from a Physical Standpoint, by A. E. Dolbear; A Dynamical Hypothesis of Inheritance, by J. A. Ryder; On the Limits of Divisibility of Living Matter, by J. Loeb; Cell Division and Development, by J. P. McMurrich; The Problems, Methods, and Scope of Developmental Mechanics, by W. Roux; and Evolution and Epigenesis, by C. O. Whitman. The book is in no sense a popular one, and must find its readers among special students of biology and the related sciences.

* The Horticulturist's Rule-book. By L. H. Bailey. Pp. 302, 16mo. London and New York: Macmillan & Co. Price, 75 cents.

† The Educational Ideal. By James Phinney Munroe. Pp. 262, 12mo. Boston: D C. Heath & Co. Price, $1.

* Biological Lectures delivered at the Marine Biological Laboratory of Woods Holl, 1894. Pp. 287, 8vo. Boston: Ginn & Co. Price, $2.65.

Prof. *A. Milnes Marshall's* monograph on *The Frog*, intended as an introduction to anatomy, histology, and embryology, was written to guide and direct the student through the practical part of this work, and met a want the whole ground of which was not covered by any manual existing at the time of the original publication. It gives, in the introduction, practical instruction in the methods employed in biological investigation; followed by the application of these methods to the anatomical and histological examination of the animal; the frog being selected because it is easy to get and convenient to dissect, and is a fairly typical example of the group of vertebrates. The preparation of the present, the fifth, edition was Prof. Marshall's last professional act, and was completed only a week before his death. (Manchester and London: Smith, Elder & Co. New York: Putnams, $1.40.)

An Elementary Text-book of Mechanics, by *R. T. Glazebrook*, is the latest of the Cambridge Natural Science Manuals to reach us. The most satisfactory method of teaching the natural sciences is by means of experiments which can be performed by the learners themselves. This book consists of a series of such experiments which have been used by the author in teaching his classes; the experiments are followed by an explanation and an account of the deductions to be drawn from them. (Macmillan, $1.25.)

Imagination in Dreams, by *Frederick Greenwood* (Macmillan & Co., $1.75), treats of a subject with which most of us are familiar through personal experience. Two essays, previously published in English periodicals, form the foundation for the work, which as a whole is a rather unscientific discussion of curious psychic phenomena, which are in many cases closely allied, and dependent on morbid and diseased conditions of body and mind, and very probably have little value in determining the normal working of the brain. A number of queer dreams are detailed, many of them the author's own products. He thinks that the limits generally set for the imagination are at times overleaped in sleep and that "some dream visions are creations of the mind."

Volume XXXII, Part I, of the *Annals of the Astronomical Observatory of Harvard College* contains an interesting statement of the methods in astronomical photography followed at the Harvard Observatory. There are also two chapters giving the results of researches by Prof. *William H. Pickering* on the Great Nebula in Orion and on the lunar surface. The former was conducted exclusively by photography while the latter embraced both visual and photographic observations.

Part I of Volume III of the final report on the *Geology of Minnesota* is devoted to paleontology, and is made up of contributions by Leo Lesquereux, Anthony Woodward, Benjamin W. Thomas, Charles Schuchert, Edward O. Ulrich, and Newton H. Winchell. Prefixed to the special monographs which it contains is a historical sketch of investigation of the Lower Silurian in the upper Mississippi Valley. The report is printed in large quarto form, and the present part is illustrated with about forty plates, besides figures in the text.

Prof. *N. Story-Maskelyne* describes his *Crystallography* as a treatise on the morphology of crystals (London: Frowde, 12*s.* 6*d.*; New York: Macmillan, $3.50). In addition to giving full descriptions of the several systems of crystallization, he discusses the properties of zones and the varieties of symmetry possible in a crystalloid system of planes. He also describes modes of representing crystals and of measuring and calculating angles. While the author has deemed it necessary to treat some parts of his subject in the simplest form compatible with strict geometrical methods, he hopes that his book will not be found lacking in demonstrations that will satisfy students with high mathematical training.

In an easily readable little book *Uriel H. Crocker* essays to point out *The Cause of Hard Times* (Little, Brown & Co., 50 cents). He ascribes the recent business depression and that of 1873–'76 to overproduction, and in supporting this view he comes into conflict with Mill and other authorities of the past and present. One reason that he gives why production outruns demand is that owners of factories frequently prefer to sustain a loss that may not continue so long as to be serious rather than the certainly large loss involved in shutting down their works.

The Brush Arc Light Dynamo, by *H. C. Reagan, Jr.*, is a handbook for electrical en-

gineers and students. The author gives simple descriptions of the very latest Brush dynamos and a list of instructions for use in emergencies. A novel feature is a revolvable celluloid chart. This chart represents a Brush dynamo with a revolvable armature. It shows the manner of cutting the lines of force, the directions of the flow of current induced in the armature coils, the method of commuting the current, and the flow of current to the external circuit and return to the negative brush. The book has been approved by the Brush company. (N. W. Henley & Co., N. Y.)

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Fragments of Science.

A Device for Geological Teaching.—It is now six years since there was issued a small edition of an educational appliance invented by James T. B. Ives, F. G. S., and appropriately named by him the Strata Map. Since that time the inventor has made various improvements, and is now bringing out his map in a more completely satisfactory form than heretofore. Hanging on the wall it appears as a geological map of the United States, east of Denver, in the ten colors recommended by the International Congress of Geologists for the coloration of geological maps. On touching the fastening at the upper edge of the frame, the glazed front may be let down. It is then found that the map consists of ten cards, each of one color, all the cards being cut away so that part of each is exposed to view. The uppermost card represents the Quaternary, and all is cut away except so much as correctly represents the Quaternary beds on the surface of the region. The next card below it exhibits the Neocene areas in the same manner, cropping out from underneath, and extending beyond, the Quaternary. Then follows the Eocene, succeeded by the Cretaceous, which again is underlaid by the Jurasso-Triassic, and so forth. Finally, the foundation represents the Archæan systems collectively, and is seen exposed where the well-known Archæan areas occur. The fact of superposition of the formations is brought home to the student by this device, while denudation is illustrated by the cutting away of parts of the several cards. Such resultant phenomena as inliers and outliers are seen, also escarpments, the edge of each card forming one in miniature; while by tilting or bending the cards, dip and strike with synclinal and anticlinal folding may be illustrated as well as conformability of stratification. One important advance which the inventor has made since the earlier output of his work is the embossing of the Archæan foundation and all the superposed strata so as to bring the whole to a plane surface.

More recently Mr. Ives has been occupied with the problem of constructing relief maps combining strength and lightness with moderate cost, printed maps being used to furnish the geographical details in which relief maps are often so deficient. One novel feature is the combination of distinctive colors, to represent successive levels, with actual relief. Regions that are less than one hundred feet above sea level are colored buff; from one hundred to five hundred, light green, and so on; there being eight stages in all, represented by eight well-contrasted colors.

These maps are made of specially prepared paper, and the means by which the inventor contrives to emboss them while still retaining the register—that is to say, making the printing on the map exactly correspond to the mountain peaks and river courses of the embossed foundation—is a secret not yet divulged.

The structural and artistic finish of these maps exhibits the painstaking of one who himself appreciates the value of his work. They received a diploma and medal at the Columbian Exposition, both in the Liberal

Arts department and also in that of Mines and Mining, and have been heartily commended by many prominent geologists and educators, including the late Profs. James D. Dana, Alexander Winchell, and John S. Newberry, Profs. James Hall, E. D. Cope, and N. S. Shaler, and President D. C. Gilman.

The Davenport Academy of Sciences.—The Davenport Academy of Natural Sciences has just received a legacy of ten thousand dollars from Mrs. Mary Putnam Bull, of Tarrytown. N. Y. It is given as a memorial to her brother, Charles E. Putnam, and his son, J. D. Putnam, who were, during their lifetime, among the chief promoters of the academy. Wisely the gift is made a Permanent Publication Fund. The academy has already published five volumes of Proceedings, and a sixth volume is in progress. Among many valuable papers in these volumes the entomological studies of Mr. J. D. Putnam and the archæological discussions of Dr. Farquharson are notable. Through exchange of its Proceedings the academy has acquired a valuable library comprising some forty thousand books and pamphlets. The last paper published by the academy was a seventy-two-page Summary of the Archæology of Iowa, by Prof. Frederick Starr. The academy is now organizing a comprehensive archæological survey of that State, which if fully carried out will be one of the most important archæological enterprises ever undertaken in this country. The academy is now working for a permanent fund of fifty thousand dollars, for the better equipment of its work. With its creditable past and its worthy present it may well hope for success in securing the funds necessary to insure a brilliant future.

The Growth of Preventive Medicine.—There came a time in the medical ranks, fifty odd years or so ago, says Dr. Cameron in a recent article in the Lancet, when the classification of disease threatened to become a mere cataloguing of the phenomena immediately preceding death. Indeed, a certain hopelessness, begotten of this mistake, threatened to sap the energies of the physicians. When Sydenham had, two centuries ago, introduced a rational and hygienic element into treatment, he had also, as it were, pointed in the direction to which, when the hopelessness referred to came upon us, we might look for the prevention of disease itself. A belief, therefore, in the value of cleanliness, fresh air, and reasonable diet, along with a certain not altogether unhealthy skepticism as to the need in every case of drugs, was not the least important weapon in the armament of the young physician of thirty years ago. And although new drugs always find new votaries, and many of them have great value, the absolute usefulness of all mere remedial measures is at the present time looked upon as very slight compared with the shielding influence which the physician exercises in placing his patient under the most favorable circumstances for Nature to effect her cure. And it is largely this belief in conquering Nature by obeying her, lighted up by a certain afterglow of the hopelessness already spoken of, which has caused so much of the energy of the medical profession and the sanitary authorities to be thrown into the preventive service. While, therefore, the ancient physician was strong chiefly in his acquaintance with and prophecy as to the probable results of the diseases which he was called upon to treat, the modern hygeist attempts to grapple with the remoter causes of those processes themselves, not in the individual alone, but also in the community.

Color Nomenclature.—In music and form we have specific and generally accepted terms for describing definite sense perceptions, but in the case of color nothing that can be called even a system exists. The terms vermilion and ultramarine, which have been used by many of our best authorities, for want of anything better, are nevertheless used for very variable concepts. The difference between a Chinese and a German vermilion in pigments is very noticeable. A Winsor & Newton chrome yellow and a German chrome yellow differ by more than twenty-five per cent of yellow. Among several samples of blue pigments a still greater variation is generally found; while such terms as olive, citrine, russet, crushed strawberry, baby blue, ashes of roses, peacock blue, and a host of others, have practically no exact significance whatever. This uncertainty and lack of a standard have caused naturalists much inconvenience in botanical, entomo-

logical, ornithological, and zoölogical descriptions. In applied science, in the arts, and in chemistry the inconvenience has, if possible, been even greater, and the rapid advance in the art of dyeing alone makes some system of color nomenclature absolutely necessary. Mr. J. H. Pilsbury, who has been working for some years to perfect a practical system, contributed an article on the subject to a recent copy of Nature. He says: "In order that any fixed scheme of color nomenclature may be of some practical value, it must of course be readily understood by people of ordinary intelligence, and must be complete enough to meet the ordinary wants of everyday life. There must be something that is so completely fixed as to be perfectly trustworthy for present and future needs. In the solar spectrum we have an invariable source from which to derive our spectrum standards, and upon these the whole scheme is to be based. Since the six spectrum standard (red, 6,587; orange, 6,085; yellow, 5,793; green, 5,164; blue, 4,695; violet, 4,210—the numbers indicate the wave-lengths in ten millionths of a millimetre) do not give a very extensive *répertoire* for common use, to say nothing of the needs of the more artistic, it was proposed to introduce between each two spectrum standards two intermediate hues to be formed by the union of two spectrum standards in definite proportions. Thus between orange and red would be introduced an orange-red and a red-orange. . . . It is also very desirable that the standards be produced in some material form in order that it be of any practical value. The task of reproducing the brilliant hues of the solar spectrum in pigmentary material or in glass is much more difficult than one not acquainted with the matter would suspect. In order to accomplish this, it has been found necessary to use the somewhat fugitive aniline colors." The colors thus produced, with the addition of black and white, give a fairly satisfactory system. In a later number of the same journal Herbert Spencer has a letter in which he suggests a scheme for color-naming, composed of terms patterned after those used in the compass for denoting direction; giving a form: Red, red by blue, red red blue, red blue by red, red blue, red blue by blue, blue red blue, blue by red, blue. He says: "Of course, these names would be names of pure colors only, the primaries and their mixtures with one another; but the method might be expanded by the use of numbers to each, 1, 2, 3, signifying proportions of added neutral tint subduing the color, so as to produce gradations of impurity."

Kindergartening in a New Role.—There is to be opened in Boston this fall a kindergarten settlement, to be known as the Elizabeth Peabody House. It is designed as a memorial to Elizabeth Peabody, who did so much, in the early days of kindergartening, to help the cause. The plan is to take a house in some poor and crowded quarter, and officer it with a group of eight or ten kindergarteners, normal students, and teachers. They will conduct a kindergarten, and through acquaintance with the children enter into friendly and helpful relations with the people of the neighborhood. Interesting plans are under consideration for a cooking school, a training class for nursery maids, and for mothers' clubs and classes, where helpful hints may be given as to the care of children and of the home.

Fish-bait Farms.—Fine openings for new industries are discovered by Dr. W. A. Herdman, President of the Zoölogical Section of the British Association, in the cultivation of supplies for fishermen. The Scotch long-line fishermen alone, he says, use nearly a hundred millions of mussels every time all the lines are set, and many tons of them have to be imported every year. If squid could be obtained reasonably and in sufficient quantity, it would probably prove more valuable even than mussels. A fishing firm in Aberdeen last winter paid more than two hundred pounds for squid bait for a single boat's lines from October to December, and there are fifty such boats north of the Tyne. "Here is a nice little industry for any one who can capture or cultivate the common squid in quantity." Innumerable young mussels perish around the coasts every year for want of suitable objects to attach to. The erection of proper stakes or plain *bouchots* would serve a useful purpose, at any rate in the collection of seed. Dr. Herdman further pointed out the opportunity that exists for opulent land-

owners to erect sea-fish hatcheries on the shores of their estates, and for rich merchants to establish agriculture in neighboring estuaries, and so instruct the fishing populations, resuscitate declining industries, and cultivate the barren shores, in all reasonable probability to their own ultimate profit.

The Sage School of Philosophy.—The Sage School of Philosophy in Cornell University is devoted "to the free and unhampered quest and propagation of truth" in regard to all those questions of human inquiry which are embraced by logic, psychology, ethics, pedagogics, metaphysics, and the history and philosophy of religion. Its aim is to secure comprehensiveness and thoroughness. It is founded on an endowment by the Hon. Henry W. Sage, the proceeds of which are supplemented, when necessary, with appropriations from the general funds of the university. Six scholarships and three fellowships are open to graduates of Cornell and other universities; four progressive courses of study are given, corresponding with the four years of the college course, and also seminary courses in experimental psychology, ancient and mediæval philosophy, modern philosophy, ethics, pedagogics, and the history of religion. The students are further free to select any of the courses given in the university. A psychological laboratory is attached to the institution; a philosophical club has been formed; and a periodical—the Philosophical Review—is published under the editorial direction of two of the professors, assisted by their associates.

Face-Reading.—In the acquisition of the art of speech-reading by sight, the eye of the deaf pupil becomes accustomed to certain positions of the organs of articulation, and he thus learns to understand the spoken words of others, although he does not hear them. In teaching this art, Lillie Eginton Warren has found that the forty odd sounds of the English language are revealed in sixteen outward manifestations or pictures, and practice in following them as they rapidly appear in a face enables us to understand what is said. Some faces differ from others in strength of expression, and thus many show less action in the lower part. Nevertheless, there is in all persons a general approach to a certain definite movement of muscles, particularly when in animated conversation, and the trained eye notices what the inexperienced one fails to discover. After attaining a degree of proficiency in this art of expression-reading, persons seem to feel that they hear instead of see the words spoken. Reading our language in this way may be said to be mastery of a new alphabet, the rapidly moving letters or characters of which are to be found upon the page of the human countenance.

A Dream of Railroad Development.—Forecasting, in the Engineering Magazine, the future of American railroading, Mr. H. D. Gordon assumes that the lines on which our inventors will have to do their work hereafter seem to be far more clearly defined than ever before. There is no engineering reason why a speed of one hundred miles an hour should not be maintained on fast trains; the objections are commercial rather than technical. The chief obstacle lies in the ponderous and wasteful mechanism needed to generate the requisite amount of steam under even the best methods. The remedy may be found when electric energy can be generated in a simpler and less expensive manner than hitherto. In passenger trains too many horse powers are needed to carry each ticket-holder to his destination, and too many hundredweight of dead material have to be dragged along with him. Within the carriage he is entitled to better ventilation and better light than he is apt to get, and electricity is looked to to provide him with both. Some benefit has been derived, and much more may be reasonably expected, from the experiments made in introducing steel frames into cars, and otherwise improving their structural resistance to abnormal shock or accident. Outside of the train, in signaling, a considerable advance has already been made toward having the semaphore raised and lowered by directly applied electric force; and the author anticipates that it will not be many years before a train may be seen through its successive blocks by the glare of electric lights, leaving each block in darkness as it enters and lights the next. What has already been done in railroad invention in the United States is but an earnest of what the future holds in reserve.

The Ball Nozzle.—Mr. Arthur Kitson, in an address on the ball nozzle, published in the Journal of the Franklin Institute, gives the following explanation of its apparent contradiction of natural laws: The problem connected with this invention may be put thus: Why does the ball adhere to the nozzle when there is behind it a force aggregating as high as hundreds of pounds pressure? The explanation usually given is that the atmospheric pressure holds the ball in its place and prevents it from falling or leaving the mouth of the nozzle. To this others answer that the pressure behind the ball far exceeds the atmospheric pressure; for instance, there is an exhibition given daily in New York with one of these nozzles where the water pressure equals a hundred pounds per square inch, and as the atmospheric pressure is only about fifteen pounds, it would at first sight seem that the excess of pressure on the under side of the ball was eighty-five pounds, and ought, therefore, to expel the ball. The error, however, in this argument arises from failure to distinguish between the pressure of the water when confined in the pipes and when issuing around the ball. It is very certain that if a hundred pounds pressure were acting directly upon the ball, it would be blown out of the nozzle, but it does not appear to me to act in this way. When the ball is confined to the mouth of the nozzle and pressed against it, it is undoubtedly subjected to the pressure of the water, but the moment it is raised slightly from the mouth, it is no longer subjected to this pressure, since the water is escaping all around it. In this respect it resembles the lid of a teakettle when the water is boiling. By plugging the spout, the lid will be raised by the steam pressure sufficiently to allow the steam to escape at the sides. The explanation that seems to me to be the correct one is as follows: The ball is acted upon by three forces: first, gravity; second, atmospheric pressure; and, third, the force of the issuing stream. At first, the atmospheric pressure is the same at all points, and hence gravity has free play; but as soon as the stream passes through the nozzle, the atmospheric pressure from the under side is counteracted by the momentum of the issuing water, and the ball rising to a point where the water can pass freely around the sides, without pressing materially upon the ball, we have the full pressure of the atmosphere on the under half-side of the ball resisting the force of gravity. The ball, therefore, simply serves as a deflector to divert the current of water or to spread it out, and the resistance of the atmosphere against the ball suffices not only to perform this operation but also to sustain its weight.

It is possible that the density of the air may also be somewhat increased under the ball by the action of the spray. With a heavy pressure, the ball is farther removed from the nozzle than with a light pressure. The same holds good respecting a heavy ball and a light ball.

Native Sulphur in Michigan.—Beds of native sulphur are described by W. H. Scherzar in the American Journal of Science as having been discovered during the past year in the upper Helderberg limestone of Monroe County, Mich. They lie from sixteen to eighteen feet below the surface, between a compact, dolomitic limestone and a calcareous sand rock. They consist of a yellowish-brown, impure limestone, containing fossils, and giving here and there a strong, oily odor, which, wherever exposed to view, appears to be cavernous in structure, having pockets of from a fraction of an inch up to three feet in size. These pockets contain scalenohedrons of calcite or tabular crystals of celestite, or both together; while the sulphur generally occurs in bright, lustrous masses toward the center of the cavity, intermatted frequently with the lime minerals. Fragments as large as one's fist are readily removed. Some of the smaller cavities contain nothing but pure sulphur. Nearly one hundred barrels of pure sulphur have been obtained from about an acre of this bed.

Antirabic Serum.—In the light of some of the recent experimental work of Tizzoni and Centanni, published in the Lancet, there seems little doubt that a great advance has been made in the treatment of rabies. Instead of manufacturing the antitoxic material in the body of the patient, by a process of vaccination as in the Pasteur method, Tizzoni and Centanni prepare this substance in an animal, from which it is conveyed to the individual to be treated, in the blood

serum as a vehicle. In place of using Pasteur's method of protective vaccination for the animals from which the serum is obtained, they, by a process of peptic digestion, attenuate the virus to be used. It is possible by drying to prepare a permanent form of this serum which will, if kept from air and light, remain active for a long period. It is very portable, is readily dissolved, and may be used by any one who is capable of sterilizing a hypodermic needle and syringe. The treatment, therefore, can be commenced almost as soon as the patient has received the bite, and it is not necessary that he should leave his home or his own medical attendant.

The Meaning of Race.—Attempting to frame a definition of race, Mr. W. M. Flinders Petrie remarked in the British Association that when only a few thousand years had to be dealt with, nothing seemed easier or more satisfactory than to map out races on the supposition that so many million people were descended from one ancestor and so many from another. Mixed races were glibly separated from pure races, and all humanity was partitioned off into well-defined divisions. But when the long ages of man's history, and the incessant mixtures that have taken place during the brief end of it that is recorded, come to be realized, the meaning of "race" must be wholly revised. The only meaning that a "race" can have is that of a group of persons whose type has become unified by their rate of assimilation and of their subjection by their conditions exceeding the rate of change produced by foreign elements. If the rate of mixture exceeds that of assimilation, then the people are a mixed race, or a mere agglomeration.

MINOR PARAGRAPHS.

THE Belgian Astronomical Society, founded a year ago, for the advancement and popularization of that science and of meteorology, has recently become much extended. At the meetings in May, June, and July, 1895, papers were read on the history of astronomy at the time of the Renascence, by M. Doiteau; on the observation of the scintillation of the stars, by M. Vincent; on the application of the spectroscope to the study of the constitution of Saturn's rings, by M. Stroobant; on the theories of atmospheric circulation, by M. Marchal; and on other subjects. A co-operative system of observations of shooting stars, clouds, etc., was decided upon. An annual volume of the year's results is to be published in November, and a periodical bulletin has been arranged for.

A FRENCH journal, the Chasseur illustré, tells of a Russian gentleman who, wishing to ascertain where the birds go in winter, caught a number and attached to their tails a tube containing his address and a request in four languages that whoever might find the bird again would write him concerning the place and time of the finding. He waited long for an answer, but only recently received a letter from a European prisoner captured by the Mahdi at the taking of Khartoum, relating that a follower of the Mahdi in Dongola had killed one of the birds in November, 1892, and, not being able to read the paper, had brought it to him. The prisoner, in his glad surprise at receiving a letter from Europe in so strange a way, embraced the first opportunity on regaining his liberty to answer it.

THE influence that the bearing of one man or nation may exert upon another is exemplified by what Mr. W. M. Flinders Petrie said in the British Association concerning the condition in the East, where an interminable system of reprisals in defrauding and exacting prevails. "The Egyptians are notorious for their avarice, and are usually accredited with being interminable money-grabbers; yet no sooner do they find that this system of reprisals is abandoned and strict justice maintained than they at once respond to it; and when confidence has been gained, it is almost as common to find a man dispute an account against his own interest as for himself, and scarcely ever is any attempt made at false statements or impositions. Such is the healthy response to straightforward dealing with them."

THE purpose of the new division of agrostology in the United States Department of Agriculture is investigation and experiment upon grasses and other forage plants, in

order to determine their adaptability to cultivation and use in this country; to inform the people concerning them; and to introduce those which promise well—whether native or foreign—into cultivation. A small plot has been furnished on the grounds of the Department of Agriculture on which four hundred varieties of grasses and forage plants are growing for the testing of their qualities, and a larger garden has been established in one of the Southern States. The division has in preparation a popular book on the grass and forage plants of the country, also a larger illustrated handbook on the grasses of North America.

A CURIOUS system of water cure is practiced by Sebastian Kneipp at Woerishofen, Bavaria. Its most striking feature is the importamce it attributes to the action of water on the lower extremities. Patients are caused to walk in running water or on the dewy turf, or on flagstones freshly watered; and baths are prescribed without after-use of the towel or rubbing, the bather being instructed to dress himself as quickly as he can, and let the reaction take place in his damp shirt. The system is mentioned by M. E. Bottey in his theoretical and practical treatise on the water cure (Paris, 1893) as possibly affording the hygiene and *régime* which some diseases require, but as dangerous in most cases.

NOTES.

CONSIDERABLE attention has lately been given in London to the question of the spread of infectious diseases among horses through the public watering troughs. There seems good reason to believe that this is a common source of infection, especially for glanders. One parish has gone so far as to abolish the ordinary troughs and replace them by a stopcock and a pail.

IN speaking of Prof. Ludwig, one of the most persistent of vivisectors, Dr. Mosso says: "Ludwig, the greatest of vivisectors, was president of the Leipsic Society for the Protection of Animals, and remained to the last one of its most active members. Germany owes to him that her horses and beasts of burden are now humanely treated. To him is due the awakening of the true humanitarian spirit toward the brute creation that culminated in the 'Union of German Societies for the Protection of Animals.'"

PROF. CHARLES S. MINOT, of the Harvard Medical School, has arranged a course in embryology for students wishing to make a special study of this branch. The course is open to registered students of the graduate department of the Faculty of Arts and Sciences, and will be offered hereafter also as a special course to graduate students of the medical school. The course extends through a year of two terms, and will consist of lectures and laboratory work. Students taking the course will be expected to devote to it not less than eighteen hours a week. For persons having medical degrees the fee for one term is seventy-five dollars; for the whole year, one hundred and twenty-five dollars. Others must enter the university as graduate students under the Faculty of Arts and Sciences.

AT a recent meeting of the Berlin Pharmaceutical Society, Dr. Seidler read a paper on the bacteria in mineral waters. He had made an elaborate series of experiments and found bacteria in all the bottled mineral waters, artificial as well as natural. The waters, as a general thing, were practically germ-free as they emerged from the earth, but bacteria developed rapidly, through carelessness in washing the bottles, corks, etc.

THE mineral statistics of the United Kingdom of Great Britain for 1894 have been issued as a blue book. The total production of coal for the year was 23,125,983 tons; the approximate price at the pits about $1.75 per ton.

THE seventh session of the Australasian Association for the Advancement of Science will be held in Sydney, from the 3d to the 10th of January, 1897, under the presidency of A. Liversidge, Professor of Chemistry, University of Sydney. Communications and papers for the meeting, or inquiries, may be addressed to the permanent honorary secretary, The Chemical Laboratory, The University of Sydney, N. S. W.

DR. ALBERT E. FOOTE, of Philadelphia, a distinguished mineralogist, died at Atlanta, Ga., where he had gone in charge of the Pennsylvania mineral exhibit, October 10th. He had been in feeble health for some time. He was born in Hamilton, N. Y., in 1846; was graduated in medicine from the University of Michigan in 1867; taught at Ann Arbor; and was for five years Professor of Chemistry and Mineralogy in Iowa State College. In 1876 he removed to Philadelphia and became a professional mineralogist and a dealer in minerals and scientific books.

PROF. H. HELLRIEGEL, an active and efficient investigator in agricultural chemistry, died at Bernburg, Anhalt, Germany, September 24, 1895. He was best known for the researches into the fixation of nitrogen by leguminous plants, in which the joint agency of microbes and nodules on the roots of the plants was determined.